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ABSTRACT

This project validated the competencies and curriculum for telecommunications technology programs and specified a generic curriculum design/structure that could be useful to community colleges and technical institutes that are beginning or revising their curricula. The project took advantage of and built upon the first program development work done by Texas State Technical Institute-Sweetwater (TSTI), North Harris County College, and the Center for Occupational Research and Development. A project advisory committee from these institutions met to combine and organize the task inventory, job analysis, duty list, competencies, and other related curriculum elements of the programs of North Harris County College and TSTI. The curriculum elements were validated, with emphasis on competencies, and the results were then structured into a generic curriculum design. The curriculum was validated and is contained in this document. Needed equipment and resources are listed in the document. (KC)

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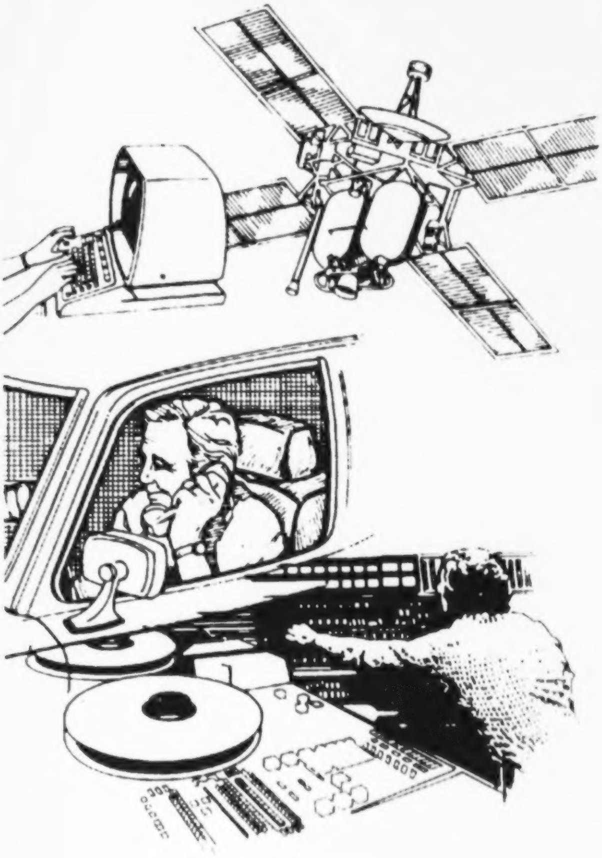
GENERIC CURRICULUM

FOR

TELECOMMUNICATIONS PROGRAMS



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A Joint Project

Texas State Technical Institute-Sweetwater

North Harris County College, East Campus

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GENERIC CURRICULUM FOR TELECOMMUNICATIONS PROGRAMS

FINAL REPORT

THIS PROJECT WAS FUNDED BY THE TEXAS HIGHER EDUCATION COORDINATING BOARD THROUGH A GRANT UTILIZING FUNDS FROM THE CARL D. PERKINS VOCATIONAL EDUCATION ACT.

Project Number 8810302
Project Year 1988

A Joint Project
Texas State Technical Institute-Sweetwater
North Harris County College, East Campus

Project Director: Dr. Kent Brooks

Project Developers: John White
Jim Alleman
James Lovett
Gail Phillips

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Texas State Technical Institute (TSTI-Sweetwater) sincerely appreciates the contributions made by several individuals and organizations to make this project a success.

Special thanks are due to the Coordinating Board for its foresight in providing funding for the project. Mike Roark was the project officer.

The collective input from the joint advisory committee of Telecommunications Technology programs at TSTI-Sweetwater and North Harris County College was particularly beneficial to the project work. Their names and company affiliations follow:

Committee Members	Organization
Sudqi Alayyan	Texas Tech University, Lubbock
James Allen	Westex Towers, Inc., Sweetwater
Roger Dennis	Dennis Communications, Abilene
Keith Johnson	KTAB-TV, Abilene
Jim Kelley	Southwestern Bell Telephone, Houston
Ray Labelle	Centel, Houston
Jim Maxey	Centel, Houston
Charles R. 'Dick' McAdams	CRM^{c} Inc., Houston
John Nicholas	American General Life Insurance, Houston
Steve Nichols	Intertel, Houston
D. K. Roberson	Centel, Houston
Albert Scarborough	United Cable TV, Abilene
Mark Shafer	Motorola Communications and Electronics Inc., Spring
Jerry Ratzlaff	Southwestern Bell Telephone, Plano
Jim Sinopoli	OMT Engineering, Austin
James Bob Tabor	FAA, Houston
Maureen Weyel	Southwestern Bell Telephone, Houston

The project faculty-staff are also to be commended for their diligent efforts. John White, Program Chairman for Telecommunications Technology at TSTI-Sweetwater, Abilene Extension, served as Project Developer. Gail Phillips, Division IV Head at North Harris County College, coordinated the sub-contract activities at North Harris County College and served as Project Developer. He was assisted by Jim Alleman, Coordinator of Electronics Technology at North Harris County College, and Barbara Sirianni, Division Secretary. Their combined expertise was very benificial and their participation in the projet is highly appreciated.

A special acknowledgement is extended to Henry Klingler, Instructor in Telecommunications at TSTI-Sweetwater, Abilene Extension, for his assistance in developing the task inventory, defining the telecommunications industry, and developing the generic curriculum. Also special thanks are extended to James Lovett, Research Associate, Center for Occupational Research and Development (CORD), for his superb work in validating the curriculum competencies and his assistance relative to the curriculum design.

Grateful appreciation is extended to Dr. Clay Johnson, President of TSTI-Sweetwater, and Dr. Nellie Thorogood, President of North Harris County College, East Campus, for identifying the need for this project, and their support during the project. Susan Pearson, Dean of Instruction, and Kenne Turner, Engineering Technology Coordinator at North Harris County College, are also commended for their participation in the advisory committee meetings.

PURPOSE OF PROJECT

One of the few industries in Texas which is experiencing technological and economic growth in a boom-time atmosphere is telecommunications. The rapid development of this industry has caught Texas two-year colleges and technical institutes without adequate programs or curricula for training technicians for the field. Only in the last three years have schools developed programs to meet this growing need in the labor force. Two of these schools, TSTI-Sweetwater and North Harris County College, developed new programs, but the programs needed additional validations by industry.

The purpose of this project was to validate the competencies and curriculum for telecommunications technology programs and to specify a generic curriculum design/structure which would be useful to community colleges and technical institutes beginning or revising curricula. The project took advantage of and built upon the first program development work done by TSTI-Sweetwater, North Harris County College, and the Center for Occupational Research and Development (CORD), Waco.

PROJECT OBJECTIVES

This project had the following objectives:

1. To form a Project Advisory Committee by combining the Telecommunications Technology Program Advisory Committees of North Harris County College and TSTI-Sweetwater/Abilene.

2. To combine and organize the task inventory, job analysis, duty list, competencies and other related curricula elements of the programs of North Harris County College and TSTI-Sweetwater.

3. To validate the curricula elements with the Project Advisory Committee with emphasis upon competencies.

4. To structure the results of the Project Advisory Committee validation activity into a generic curriculum design.

5. To review and validate the generic curriculum with the Project Advisory Committee.

6. To revise the generic curriculum and draft a final report.

METHODS OF DEVELOPMENT

Key Personnel

TSTI-Sweetwater and North Harris County College are leaders in providing instruction for emerging technical fields. Both institutions rely heavily on regular input from industry advisory committees. From the outset, this project was fortunate to have access to key representatives from the telecommunications industry. The joint committee was comprised of persons who represented the breadth of the industry, including telephone, radio, television, data communications, and communications products.

The project staff was comprised of faculty members from the telecommunications departments of TSTI-Sweetwater and North Harris County College. TSTI-Sweetwater Project Developer, John White, is Program Chairman of Telecommunications at the Abilene Extension Center. He has over seven years experience as an instructor in Electronics and Telecommunications, along with over 20 years experience in the field in the U.S. Air Force and private industry. He was ably assisted by Henry Klingler, whose many years of field experience and expertise in telecommunications were extremely valuable throughout the project. Jim Alleman, Project Developer at North Harris County College, is Electronics and Telecommunications Coordinator. He has extensive industrial experience in electronics, and was instrumental in the development of the Telecommunications program at North Harris County College. Gail Phillips, Project Developer and Project Coordinator at North Harris County College, has extensive experience as an Electronics instructor in the TSTI system, as well as administrative experience as a Division Head at NHCC. Finally, James Lovett, Project Developer at the Center for Occupational Research and Development, has much industrial experience as an engineer, and has several years experience in developing telecommunications and other high technology curricula at CORD. The names, addresses and telephone numbers of the project staff are shown in Appendix 1.

Joint Advisory Committee

The Project Developers at TSTI-Sweetwater and North Harris County College contacted their respective advisory committee members, and all agreed to serve on the joint committee and participate in the project development. This Project Advisory Committee represented major telecommunications industries in Texas.

The committee served as technical content experts, provided resources to conduct the project and guided the staff in project development. As technical content experts, they provided input relative to major training concerns which need to be addressed in the curriculum, reviewed current curricula at each institution, and assisted in validating the task inventory. The committee also provided basic needs assessment information and provided names, addresses and telephone numbers of other key industry representatives. The names, addresses, and telephone numbers of the Advisory Committee are presented in Appendix 2.

The Project Advisory Committee met twice during the project. The first one-day meeting included an orientation to the project, followed by an analytical review of existing curriculum elements, assessment of the needs of industry, and recommended curricula/training emphasis. The second one-day meeting included a review of the results of the task survey, and a review and consensus of the generic curriculum structure. The committee also reviewed the contents of this report.

The quality circle approach was used to elicit responses from the advisory committee. Curriculum concerns were raised, and each participant was given an opportunity to respond in an orderly sequence. This method assured cross-sectional input from the industry representatives.

PROJECT DEVELOPMENT

Sub-contract

To facilitate project work division between the two schools, TSTI-Sweetwater served as overall project coordinator, led in validating the curriculum competencies, coordinated the development of the generic curriculum design, and prepared the final report. North Harris County College was the principal developer of the curriculum design via sub-contract with TSTI- Sweetwater. This sub-contract also enabled North Harris County College to assist in validating the curriculum elements via sub-contract with the Center for Occupational Research and Development (CORD). The sub-contract with CORD was felt to be essential to the project because CORD's recently completed curriculum guide in Telecommunications Technology contained many elements which could be used to develop a higher quality generic curriculum. Their model for developing curricula in high technology served as a guide to the development of the project herein. A copy of each aforementioned contract is presented in Appendices 3 and 4.

Development Activities

The project developers at TSTI-Sweetwater and North Harris County College communicated with each other frequently to discuss the progress of the project. The Project Director met on a regular basis with the TSTI-Sweetwater/Abilene Project Developer to review progress and to plan the work. In addition, the project staff met twice in Abilene to plan project activities, advisory committee meetings, and the final report.

After the first project staff meeting, telecommunications curriculum elements were assembled and prepared for advisory committee input. A needs assessment instrument was also developed for use during the first advisory committee meeting, which was held at North Harris County College. The meeting was attended by all except one committee member. The agenda and minutes of this meeting are presented in Appendix 5.

During the course of the project, the project staff learned that a new curriculum in Telecommunications Technology had been published by the Center for Occupational Research and

Development. James Lovett from CORD was invited to present the competency list and generic curriculum prepared by CORD to the first advisory committee meeting. This presentation was well received and the consensus was that the TSTI/NHCC project should also build upon the work completed by CORD. Therefore, the project staff contacted the Coordinating Board about the feasibility of using some of the funds from the NHCC sub-contract and to employ CORD to assist in validating the competencies and curriculum elements. This did not present a problem, and CORD was involved to use the task inventory prepared by the TSTI-Sweetwater staff, merge it with the CORD task inventory, survey 127 industry representatives provided by the advisory committee, analyze the results, and prepare a matrix of generic curriculum course and task relationships. The results of the CORD work were presented during the second advisory committee meeting in Houston.

The project developers met a second time in Abilene to develop a tentative generic curriculum, discuss progress on the CORD activities, develop a proposed equipment list, discuss the final report, and determine the curriculum elements to be discussed during the second advisory committee meeting. Parts of the final report had already been prepared and these were reviewed by the project staff and corrections and additions made.

The second advisory committee meeting included a presentation of the validated competencies, matrices of task and course relationships, and a presentation of the proposed generic curriculum. The advisory committee also reviewed a draft of the final report and made suggestions relative to the contents of the report. A copy of the second advisory committee meeting minutes is presented in Appendix 6.

Following the second advisory committee meeting a draft of the final report was assembled for review by the Coordinating Board staff before final publishing.

RESULTS

Review of Telecommunications Curricula

The project staff identified three noteworthy curricula resources which provided valuable input to this project. These are briefly described below.

1. Name of Organization: International Communications Association

   Address: 12750 Merit Drive, LB 89, Dallas, TX 75251 Phone (214) 233-3889
   Name of Publication: Recommended Areas of Telecommunications Competencies

Abstract of Publication: The Academic Development Committee of the International Communications Association works with universities to develop and upgrade telecommunications programs. This document outlines topics in which professional personnel in the telecommunications industry should be familiar. The competencies are grouped according to basic telecommunications topics, and by three tracks as shown on the following page. These topics and competencies were prepared to guide university personnel in developing baccalaureate level curricula. However, the basic telecommunications topics and parts of the technical track would have application in two-year technical programs.

The ICA committee recommended rearranging the list to meet the needs and interest of the student and the institution. The list implies more material than can be covered in an Associate Degree, Bachelor Degree, or even a Master level program.

ICA Recommended Areas of Telecommunications Competency

Basic Telecommunications Topics

- Telecommunications Basic Concepts
- Telephone Systems
- Data Communications
- Industry Survey
- Data Systems
- Telecommunications Internship
- Economies of Telecommunications Systems

Technical Track

- Transmission Systems
- Digital Systems
- Switching Technologies
- Network Engineering
- Protocols and Interfaces Laboratory
- Computers in Telecommunications
- Electrical Engineering Fundamentals
- Technical Communicating
- Statistics

Management Track

- Transmission Systems
- Network Management
- Network Planning and Design
- Communications Security
- Telecommunications Systems Laboratory
- Computers in Telecommunications
- Project Management
- RFBs, RFPs and RFIs
- Business Communications
- Organizational Communications

Policy/Regulatory Track

- Network Management
- Telecommunications Laboratory
- Standards
- Information Privacy and Security
- Telecommunications Regulation, Policy and Law
- Legal Cases in Telecommunications
- Business Law
- Contract Law
- Business Communications

2. Name of Organization: National Telecommunications Education Council, North American Telecommunications Association

Address: 2000 M Street, N. W.
Suite 550
Washington, D.C. 20036

Phone: (202) 296-9800

Name of Publication: Curriculum of a 2-Year Associate Degree in Telecommunications Technology

Abstract: This curriculum is designed to prepare two-year telecommunications graduates in the areas of installation, equipment maintenance, and switching activities. Physics is the preferred science coursework, but students who wish to transfer to four-year institutions should also consider calculus and chemistry. Following is a list of courses recommended by this curriculum:

General Education Courses

- English Composition
- Technical Writing
- Interpersonal Communication
- Technical Math I
- Technical Math II
- Physics I
- Physics II

Technical Courses

- Basic Circuit Analysis
- AC Circuit Analysis
- Solid State Circuits
- Digital Circuits
- Linear Integrated Circuits
- Microprocessors
- Basic Analog and Digital Communications
- Data Communications
- Communications Systems

3. Name of Organization: Washtenaw Community College

Address: 4800 East Huron Drive
P.O. Box D-1
Ann Arbor, Michigan 48106-0978

Phone: (313) 973-3456

Name of Publication: Telecommunications Technology Associate Degree Programs

Abstract: The Washtenaw Community College Telecommunications Technology Program is designed to train entry-level technicians to install, repair, maintain, and operate telecommunications equipment. The program emphasizes hands-on experience. The curriculum includes a weekend college to serve industry personnel. The courses offered in the curriculum follow:

General Education

Communication Skills
Government and Society
College Algebra
Human Relations
Introduction to Telecommunications

Technical Courses

Fundamentals of Electricity I
Switching Logic
Fundamentals of Electricity
Computer Systems I
Basic Electronics
Computer Systems II
Digital Communications I
Digital Electronics
Transmissions Systems
Software Concepts
Digital Communications II
Electronic Analog Circuits
Switching Systems

4. Name of Organization: Center for Occupational Research and Development

Address: 601 C Lake Air Drive
Waco, TX 76710

Phone: (817) 772-8756

Name of Publication: Telecommunications Curriculum Guide

Abstract: This publication contains three chapters of curriculum information and appendices. Chapter 1 provides a definition and description of the expanding telecommunications industry. Chapter 2 gives the projected workforce needs in the telecommunications industry. Chapter 3 looks at knowledge and skill requirements for telecommunications technicians. This competency list was used to build the task/competency list discussed later in this publications. Chapter 4 provides a structure and content for a telecommunications curriculum, which was used extensively in this project to build the generic curriculum. Chapter 5 contains program planning and implementation information, which has also been useful in developing this project. Finally, appendices include a telecommunications survey questionnaire, course outlines and a list of references.

Committee Needs Assessment

A needs assessment questionnaire was administered to the industry participants at the first joint advisory committee meeting. The results of this assessment are shown in Appendix 7. The following findings are drawn from this survey:

1. There is a growing need or trend for highly trained telecommunications technicians in the companies represented by the joint advisory committee members.

2. All companies represented by the joint advisory committee employ telecommunications technicians.

3. There is a shortage of qualified telecommunications technicians in a majority of the companies represented by the joint advisory committee.

4. All companies represented by the joint advisory committee would be willing to hire graduates in telecommunications technology.

5. All companies represented by the joint advisory committee would give special consideration to employing persons with an Associate Degree in Telecommunications Technology, as opposed to an applicants who do not have a degree.

6. All except one of the companies represented by the joint advisory committee indicated that their industry would likely pay more at job entry for a person with an Associate Degree in Telecommunications Technology, as opposed to a person who did not have a degree.

7. The starting salary range for entry-level telecommunications technicians is $15,000 or above in companies represented by the advisory committee.

8. In companies represented by the joint advisory committee, a person with a telecommunications technology degree would likely have a greater job assignment and have greater promotion opportunities.

9. The areas the advisory committee felt that telecommunications technicians should receive training were also checked. These are ranked by number of responses below.

Name of Technical Training Area	Number of Responses
Transmitters and Receivers	7
Analog and Digital Systems	7
Digital	7
Safety	7
Fiber Optics	6
Telephone Systems	6
Electronic Circuits	6
Solid State Devices	5
Advanced Mobile and Fixed Radio	5
Opto/Laser Technology	5

Microwave and Satellite	5
Operational Amplifiers	5
Microprocessors	5
Computer Applications	5
Drafting	4
Cable Television	3
Video Generation and Processing	3
Image Processing	2
Broadcast	2
P C Communications	2
Program Input Devices (Added)	1
Operating Systems-InterfaceRequirements (Added)	1
Data Communications (Added)	1
MS-DOS (Added)	1
Schematic Reading (Added)	1
Manufacturing Processes (Added)	1
Management (Added)	1

The latter areas were added as the committee members completed the survey.

The respondents to this questionnaire represented the following industries: broadcast television, insurance, financial services, voice/data/microwave consulting, telephone company, air traffic control, communication engineering, and radio communications.

Existing Curricula Structures

During the first advisory committee meeting, the existing telecommunications curricula at TSTI-Sweetwater, North Harris County College, and the Center for Occupational Research and Development were reviewed. These curricula are shown in Appendices 8, 9, and 10. It was noted that the two-year Associate of Applied Science Degree at TSTI-Sweetwater requires six quarters (12 weeks each) of study. TSTI's Abilene Extension Center must offer a certificate program in telecommunications rather than an Associate Degree. Due to agreements with the private four-year institutions in Abilene, the general education core courses cannot be offered. However, the Abilene students may complete the Associate Degree in Sweetwater. The TSTI curriculum also contains a four quarter core curriculum which is common to technology programs in Telecommunications, Automation/Robotics, Computer Maintenance and Electronics.

North Harris County College offers a four-semester (2-year) Associate of Applied Science degree. Each semester is 16 weeks. There are co-requirements and "stopping point" courses students must master before continuing to other courses. The telecommunications option is a specialization within the Electronics program offered at the North Harris County College East Campus. A computer hardware specialization is offered at the South Campus. Courses are available which cover each aspect of electronics training.

The associate degree curricula at both schools are required by the Southern Association of Colleges and Schools to include 15 semester hours (24 quarter hours) of general education courses. The general education core course requirements at TSTI-Sweetwater are shown in Appendix 11.

The Center for Occupational Research and Development has recommended a pattern for classifying a generic curriculum. It is outlined as follows:

Common Needs of Technicians

1. System Orientation - broad based.

2. Combination of Skills -- interdisciplinary (electrical, mechanical, fluid, thermal, optical, microcomputers)

3. Strong Technical Base

4. Interpersonal Communication Skills

Common Course Needs

1. Support Courses
    a. Math
    b. Communication
    c. Shop Skills
    d. Graphics
2. Principal Courses
    a. Physics
    b. Chemistry - Materials Properties
    c. Electrical Fundamentals
3. Technical Courses
    a. Electrical
    b. Electronic
    c. Electromechanical
    d. Mechanical
    e. Fluids
    f. Heating and Cooling

Advisory Committee Input

After reviewing existing curricula models in the first advisory committee meeting, the industry participants were asked to give their input relative to a generic curriculum. Their responses are summarized here.

1. A need exists for network management and troubleshooting skills, and software and hardware related skills.

2. Technicians should be able to determine whether an on-the-job problem is hardware or software related. They need to know the relationship between hardware and software problems and be able to switch from one application mode to another.

3. A technician also needs to be skilled as a company salesperson, have good verbal communication skills, and be able to make a technical presentation.

4. Technicians should have more exposure to and a general appreciation for data communications. They need knowledge of the differences between telephones and modems. There is a need for basic telephony knowledge and skills, and broad and basic knowledge of how data communication systems work. Industry can provide the "fine tune" training on the job.

5. Basic electricity (power and grounding) skills are needed, along with a general knowledge and understanding of operating systems, cabling, basic troubleshooting skills, basic AC/DC circuitry, and digital and microprocessor circuitry.

6. Computer software skills are needed in areas of keyboard, MS-DOS, PASCAL, and BASIC.

7. Circuit board projects should be included in the curriculum.

8. Technical management skills are important, but the primary focus of the schools should be technical skills. Companies can develop management skills in management candidates.

9. Include basic knowledge of digital communication, basic block diagrams and switching systems. Telephony should be a separate course.

10. Knowledge of all operation systems is important, along with an understanding of concepts and methods of "debugging" operation systems.

11. Cooperative education experience should be provided when possible to provide experience that the marketplace demands.

There was a consensus among the advisory committee that the curriculum should provide broad-based knowledge and skills in telecommunications. The technician can receive specialized training on the job. A generic curriculum will produce a technician who is a "diamond in the rough." Training in interdisciplinary areas of telecommunications will qualify the technician to seek a job in various types of telecommunications industries. No 2-year school can provide a graduate who is skilled in all aspects of telecommunications. Courses must be carefully selected to provide the best possible training to meet the needs of industry.

Each advisory committee member was asked to provide a list of ten telecommunications experts in Texas who would be willing to respond to a survey to determine technician skill needs. This request generated a list of approximately 95 experts. In addition, CORD purchased a directory of members of the National Telecommunications Education Association and selected those experts from Texas who were different from those supplied by the Advisory Committee members. The total combined list was 127. (Two of the experts live outside Texas, but are responsible for telecommunications systems in Texas.)

Validation of Competencies

Competency lists prepared by the TSTI-Sweetwater and North Harris County College telecommunications faculty were merged with the CORD competency list and developed into a questionnaire format. A copy of this questionnaire is shown in Appendix 12. This questionnaire was mailed to 127 industry representatives whose names were supplied by the advisory committee and CORD. Fifty-eight (58) questionnaires were returned for a 46 percent response rate. The names and addresses of each industry representative who was mailed a questionnaire are shown in Appendix 13. Responses to the questionnaire were analyzed using Lotus 1-2-3 and the results follow.

Addresses were given a variety of responses to select from for each competency. The responses ranged from a 0 if the importance of a competency was unknown and from 1 to 5 depending upon its significance. The responses were tallied by ignoring the "0" responses and applying a weight factor of 1 to 5 for the other responses. Then the total score was divided by the total number of people who answered 1 to 5 to obtain a weighted average. For example, the validation for competency number 1 is:

$$12\ X\ 0 + 16\ X\ 1 + 8\ X\ 2 + 10\ X\ 3 + 7\ X\ 4 + 5\ X\ 5 = 115$$

there were 46 responses for ratings 1 through 5; the resulting average score is

$$115 \div 46 = 2.50$$

This process did not identify a specific group of competencies that could be eliminated (this would have been indicated by an average score of less that 1.75); therefore the total list was used for assembling the matrices prepared as part of the remainder of the project.

```
                     TELECOMMUNICATIONS COMPETENCY SURVEY RESULTS

COMPETENCY   RESPONSE RATINGS         TOTAL      TOTAL    AVERAGE      AVERAGE SCORE
  NUMBER    0  1  2  3   4   5      RESPONSES    SCORE     SCORE           CHART
-----------------------------------------------------------------------------------------------
    1      12 16  8 10   7   5          46        115      2.50   |++++++++++++            |
    2       0  1  0  2  14  41          58        268      4.62   |+++++++++++++++++++++++ |
   3a       0  4  7 11  18  18          58        213      3.67   |++++++++++++++++++      |
   3b       8  5  6  9  17  13          50        177      3.54   |+++++++++++++++++       |
   4a       4  3  1  7  15  28          54        226      4.19   |++++++++++++++++++++    |
   4b       4  2  0  6  18  28          54        232      4.30   |+++++++++++++++++++++   |
   4c       3  8  6  8  17  16          55        192      3.49   |+++++++++++++++++       |
   5a       8  9 10 13  11   7          50        147      2.94   |++++++++++++++          |
   5b       3 12 10 12  10  11          55        163      2.96   |++++++++++++++          |
   5c       4  6 10 16   9  13          54        175      3.24   |++++++++++++++++        |
   5d       8 13 12 11   8   6          50        132      2.64   |+++++++++++++           |
   5e       4  7  5 16  11  15          54        184      3.41   |+++++++++++++++++       |
   6a       3  2  4 11  13  25          55        220      4.00   |++++++++++++++++++++    |
   6b       1  1  5 10  13  28          57        233      4.09   |++++++++++++++++++++    |
   6c       4  6 12 12  15   9          54        171      3.17   |+++++++++++++++         |
   6d       2  6 12 14  17   7          56        175      3.13   |+++++++++++++++         |
   6e       1  1  3 12  15  26          57        233      4.09   |++++++++++++++++++++    |
   6f       2  8 10 12  15  11          56        179      3.20   |+++++++++++++++         |
   6g       1  4 10 10  14  19          57        205      3.60   |+++++++++++++++++       |
   6h       1  4  6 16  16  15          57        203      3.56   |+++++++++++++++++       |
   7a       2  5  6  6  23  16          56        207      3.70   |++++++++++++++++++      |
   7b       1  6  7  7  19  18          57        207      3.63   |++++++++++++++++++      |
   7c       2  9 11  4  16  16          56        187      3.34   |++++++++++++++++        |
   7d       2  8 13  8  15  12          56        178      3.18   |+++++++++++++++         |
   7e       3  8 12  6  13  16          55        182      3.31   |++++++++++++++++        |
   7f       4  8 13  6  14  13          54        173      3.20   |++++++++++++++++        |
   7g       4  9 16  6  12  11          54        162      3.00   |+++++++++++++++         |
   7h       1  7  9 13  16  12          57        188      3.30   |++++++++++++++++        |
   8a       4 13 17 11   9   4          54        136      2.52   |++++++++++++            |
   8b       0  8 10 14  11  15          58        189      3.26   |++++++++++++++++        |
   8c       3  8  9 15  13  10          55        173      3.15   |+++++++++++++++         |
   8d       2  9  9 15  11  12          56        176      3.14   |+++++++++++++++         |
   9a       2  7  8 12  15  14          56        189      3.38   |++++++++++++++++        |
   9b       2  9  7 11  15  14          56        186      3.32   |++++++++++++++++        |
   9c       1  6  6  6  20  19          57        211      3.70   |++++++++++++++++++      |
   9d       2  9  8  9  15  15          56        187      3.34   |++++++++++++++++        |
   10       8 20  9 12   4   5          50        115      2.30   |+++++++++++             |
   11       0  0  4 11  15  28          58        241      4.16   |++++++++++++++++++++    |
   12       2 10 13 16  10   7          56        159      2.84   |++++++++++++++          |
   13       1  8 16 10  13  10          57        172      3.02   |+++++++++++++++         |
   14       2  4 17 12  14   9          56        175      3.13   |+++++++++++++++         |
   15       3 14 18 12   7   4          55        134      2.44   |++++++++++++            |
   16a      2  8 11 12  11  14          56        180      3.21   |++++++++++++++++        |
   16b      0  8 12 12  12  14          58        186      3.21   |++++++++++++++++        |
   16c      0  8 12 13  11  14          58        185      3.19   |+++++++++++++++         |
   16d      0  8 13 13  11  13          58        182      3.14   |+++++++++++++++         |
   16e      1  8 12 14  12  11          57        177      3.11   |+++++++++++++++         |
   16f      0  8 12 14  12  12          58        182      3.14   |+++++++++++++++         |
   16g      1  8 12 13  11  13          57        180      3.16   |+++++++++++++++         |
COMPETENCY   RESPONSE RATINGS          TOTAL      TOTAL     AVERAGE      AVERAGE SCORE
  NUMBER     0  1  2  3  4   5      RESPONSES    SCORE     SCORE           CHART
-------------------------------------------------------------------------------------------
    17       1  5  4 21  15  12         57         196       3.44   |+++++++++++++++++                |
    18       1  6  3 26   8  14         57         192       3.37   |++++++++++++++++                 |
    19       2  7  0 26   9  14         56         191       3.41   |+++++++++++++++++                |
    20       0  9 17 20   8   4         58         155       2.67   |+++++++++++++                    |
    21       2 10 18 17   9   2         56         143       2.55   |++++++++++++                     |
    22       2 14 23  9   9   1         56         128       2.29   |+++++++++++                      |
    23       1 10 12 14  12   9         57         169       2.96   |++++++++++++++                   |
    24       3 10 15 16   5   9         55         153       2.78   |+++++++++++++                    |
    25       2 13 14 17   5   7         56         147       2.63   |+++++++++++++                    |
    26a      8 15  9 11  10   5         50         131       2.62   |+++++++++++++                    |
    26b      9 14  9 13   8   5         49         128       2.61   |+++++++++++++                    |
    27       5  6 15 14  11   7         53         157       2.96   |++++++++++++++                   |
    28a      3  7 10 18   8  12         55         173       3.15   |+++++++++++++++                  |
    28b      2  7  9 21   8  11         56         175       3.13   |+++++++++++++++                  |
    28c      2  6  9 21  10  10         56         177       3.16   |+++++++++++++++                  |
    28d      3  4  9 19   8  15         55         186       3.38   |++++++++++++++++                 |
    29       1  7 11 19   9  11         57         177       3.11   |+++++++++++++++                  |
    30       4  8 10 18   8  10         54         164       3.04   |+++++++++++++++                  |
    31       4 17 12 16   3   6         54         131       2.43   |++++++++++++                     |
    32       4 13  8 17  10   6         54         150       2.78   |+++++++++++++                    |
    33a      1  6 12 10   9  20         57         196       3.44   |+++++++++++++++++                |
    33b      1  5  9 10  12  21         57         206       3.61   |++++++++++++++++++               |
    33c      1  6  8 10  12  21         57         205       3.60   |+++++++++++++++++                |
    34a      1  6 11  9  10  21         57         200       3.51   |+++++++++++++++++                |
    34b      1  6  8 10  12  21         57         205       3.60   |+++++++++++++++++                |
    34c      1  6  8  9  12  22         57         207       3.63   |++++++++++++++++++               |
    35a      4  8  7 14   9  16         54         180       3.33   |++++++++++++++++                 |
    35b      3  6 10 19  11   9         55         172       3.13   |+++++++++++++++                  |
    35c      4  5  9 19   7  14         54         178       3.30   |++++++++++++++++                 |
    36a      2  4  9 13  16  14         56         195       3.48   |+++++++++++++++++                |
    36b      1  4  8 14  17  14         57         200       3.51   |+++++++++++++++++                |
    36c      2  5 11  8  15  17         56         196       3.50   |+++++++++++++++++                |
    37a      3  6 11 13  11  14         55         181       3.29   |++++++++++++++++                 |
    37b      6  6 11 11  12  12         52         169       3.25   |++++++++++++++++                 |
    38       6 17 12 11   4   8         52         130       2.50   |++++++++++++                     |
    39       7 14 16  6   7   8         51         132       2.59   |++++++++++++                     |
    40a      6 14 16 12   3   7         52         129       2.48   |++++++++++++                     |
    40b      6  6 14 12   7  13         52         163       3.13   |+++++++++++++++                  |
    41       7  9 13 13   7   9         51         147       2.88   |++++++++++++++                   |
    42a      7 19 19  7   4   2         51         104       2.04   |++++++++++                       |
    42b      6 20 18  7   6   1         52         106       2.04   |++++++++++                       |
    42c      7 18 17 10   4   2         51         108       2.12   |++++++++++                       |
    42d      3 15 18  9   7   6         55         136       2.47   |++++++++++++                     |
    43a      4  4  9  5  14  22         54         203       3.76   |++++++++++++++++++               |
    43b      2  4  5 10  15  22         56         214       3.82   |+++++++++++++++++++              |
    43c      2  3  5 10  19  19         56         214       3.82   |+++++++++++++++++++              |
    44a     12 17  8  3   5  13         46         127       2.76   |+++++++++++++                    |
    44b     12 17 10  4   6   9         46         118       2.57   |++++++++++++                     |
    44c     12 17 12  4   5   8         46         113       2.46   |++++++++++++                     |
    44d      9 15  9  7   5  13         49         139       2.84   |++++++++++++++                   |
    44e     11 17  7  8   5  10         47         125       2.66   |+++++++++++++                    |
```

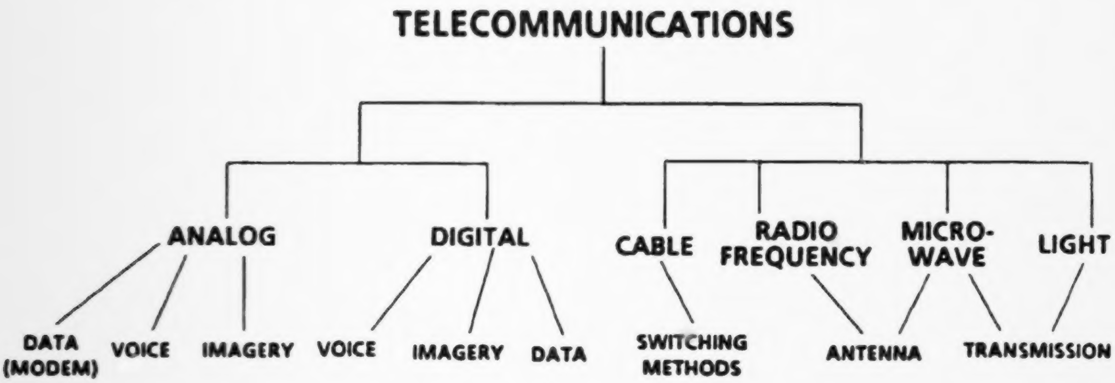
COMPETENCY NUMBER	RESPONSE RATINGS 0	1	2	3	4	5	TOTAL RESPONSES	TOTAL SCORE	AVERAGE SCORE	AVERAGE SCORE CHART
44f	10	17	8	8	4	11	48	128	2.67	+++++++++++++
44g	11	16	10	7	4	10	47	123	2.62	+++++++++++++
44h	14	18	8	7	5	6	44	105	2.39	+++++++++++
45	4	13	9	12	11	9	54	156	2.89	++++++++++++++
46	3	6	8	16	12	13	55	183	3.33	++++++++++++++++
47	8	10	17	12	8	3	50	127	2.54	++++++++++++
48a	6	15	11	9	10	7	52	139	2.67	+++++++++++++
48b	5	14	11	8	12	8	53	148	2.79	+++++++++++++
48c	5	15	10	8	11	9	53	148	2.79	+++++++++++++
48d	11	17	11	7	8	4	47	112	2.38	+++++++++++
48e	9	19	14	6	6	4	49	109	2.22	+++++++++++
48f	7	20	14	6	6	5	51	115	2.25	+++++++++++
48g	8	18	15	9	5	3	50	110	2.20	+++++++++++
48h	11	18	15	6	5	3	47	101	2.15	++++++++++
48i	10	17	15	7	5	4	48	108	2.25	+++++++++++
48j	10	17	12	8	5	6	48	115	2.40	+++++++++++
49	5	13	12	15	8	5	53	139	2.62	+++++++++++++
50a	6	13	7	14	9	9	52	150	2.88	++++++++++++++
50b	7	14	7	13	8	9	51	144	2.82	++++++++++++++
50c	8	17	14	13	4	2	50	110	2.20	+++++++++++
50d	10	16	12	10	7	3	48	113	2.35	+++++++++++
51a	5	14	7	12	12	8	53	152	2.87	++++++++++++++
51b	7	20	8	7	6	10	51	131	2.57	++++++++++++
52a	8	18	12	12	3	5	50	115	2.30	+++++++++++
52b	5	13	5	15	10	10	53	158	2.98	++++++++++++++
52c	5	11	6	10	9	17	53	174	3.28	++++++++++++++++
53a	6	13	10	8	12	9	52	150	2.88	++++++++++++++
53b	7	16	12	6	10	7	51	133	2.61	+++++++++++++
54a	3	11	4	18	9	13	55	174	3.16	+++++++++++++++
54b	3	11	6	14	11	13	55	174	3.16	+++++++++++++++
54c	4	12	8	16	7	11	54	159	2.94	++++++++++++++
55a	5	15	11	10	9	8	53	143	2.70	+++++++++++++
55b	5	17	11	9	8	8	53	138	2.60	+++++++++++++
55c	5	16	10	11	8	8	53	141	2.66	+++++++++++++
55d	5	17	11	9	8	8	53	138	2.60	+++++++++++++
55e	5	17	11	12	7	6	53	133	2.51	++++++++++++
55f	5	16	11	13	7	6	53	135	2.55	++++++++++++
55g	5	17	10	14	6	6	53	133	2.51	++++++++++++
55h	6	17	10	13	6	6	52	130	2.50	++++++++++++
56	6	15	13	6	7	11	52	142	2.73	+++++++++++++
57	6	15	13	8	6	10	52	139	2.67	+++++++++++++
58a	5	17	11	11	5	9	53	137	2.58	++++++++++++
58b	6	25	9	8	7	3	52	110	2.12	++++++++++
58c	6	25	9	8	6	4	52	111	2.13	++++++++++
58d	6	24	12	7	5	4	52	109	2.10	++++++++++
58e	6	20	7	10	7	8	52	132	2.54	++++++++++++
59	0	3	7	7	16	25	58	227	3.91	+++++++++++++++++++
60	0	3	6	10	13	26	58	227	3.91	+++++++++++++++++++
61	2	9	10	7	14	16	56	186	3.32	++++++++++++++++
62	2	16	16	10	7	7	56	141	2.52	++++++++++++
63	3	12	10	11	10	12	55	165	3.00	+++++++++++++++

COMPETENCY NUMBER	RESPONSE RATINGS 0	1	2	3	4	5	TOTAL RESPONSES	TOTAL SCORE	AVERAGE SCORE	AVERAGE SCORE CHART
64a	1	6	9	8	14	20	57	204	3.58	+++++++++++++++++
64b	3	8	11	6	12	18	55	186	3.38	++++++++++++++++
64c	3	9	10	7	11	18	55	184	3.35	++++++++++++++++
64d	3	11	11	6	11	16	55	175	3.18	+++++++++++++++
64e	3	7	12	6	13	17	55	186	3.38	++++++++++++++++
65a	5	13	19	13	5	3	53	125	2.36	+++++++++++
65b	4	12	22	12	6	2	54	126	2.33	+++++++++++
65c	4	13	21	13	5	2	54	124	2.30	+++++++++++
66	3	1	5	13	20	16	55	210	3.82	+++++++++++++++++++
67	1	4	7	10	25	11	57	203	3.56	+++++++++++++++++
68	2	5	10	9	21	11	56	191	3.41	+++++++++++++++++
69	5	16	15	11	8	3	53	126	2.38	+++++++++++
70a	7	8	8	13	9	13	51	164	3.22	++++++++++++++++
70b	3	8	9	14	10	14	55	178	3.24	++++++++++++++++
70c	3	8	9	15	9	14	55	177	3.22	++++++++++++++++
70d	3	8	9	16	9	13	55	175	3.18	+++++++++++++++
70e	4	8	9	15	9	13	54	172	3.19	+++++++++++++++
70f	4	8	10	14	7	15	54	173	3.20	++++++++++++++++
71	6	9	9	16	9	9	52	156	3.00	+++++++++++++++
72	3	7	8	18	11	11	55	176	3.20	++++++++++++++++
73	4	8	8	21	10	7	54	162	3.00	+++++++++++++++
74	7	10	15	14	6	6	51	136	2.67	+++++++++++++
75a	3	9	10	19	12	5	55	159	2.89	++++++++++++++
75b	3	7	9	22	9	8	55	167	3.04	+++++++++++++++
75c	2	9	6	23	10	8	56	170	3.04	+++++++++++++++
76	4	7	12	16	7	12	54	167	3.09	+++++++++++++++
77	7	10	12	10	10	9	51	149	2.92	++++++++++++++
78	4	17	12	11	7	7	54	137	2.54	++++++++++++
79	3	12	11	10	8	14	55	166	3.02	+++++++++++++++
80	0	9	5	17	11	16	58	194	3.34	++++++++++++++++
81	4	18	15	9	8	4	54	127	2.35	+++++++++++
82	6	21	17	7	5	2	52	106	2.04	++++++++++
83	2	9	11	7	10	19	56	187	3.34	++++++++++++++++
84	5	21	15	7	4	6	53	118	2.23	+++++++++++
85	2	11	9	15	8	13	56	171	3.05	+++++++++++++++
86	10	21	14	6	1	6	48	101	2.10	++++++++++
87a	11	21	11	3	2	10	47	110	2.34	+++++++++++
87b	10	21	9	5	2	11	48	117	2.44	++++++++++++
87c	10	21	11	5	4	7	48	109	2.27	+++++++++++
87d	11	21	11	5	3	7	47	105	2.23	+++++++++++
88	8	24	8	3	7	8	50	117	2.34	+++++++++++
89	9	26	6	6	1	10	49	110	2.24	+++++++++++
90	7	20	12	7	7	5	51	118	2.31	+++++++++++
91	8	26	7	11	2	4	50	101	2.02	++++++++++
92	10	25	10	5	6	2	48	94	1.96	+++++++++
93	8	25	9	8	6	2	50	101	2.02	++++++++++
94	4	12	14	10	6	12	54	154	2.85	++++++++++++++
95	2	8	5	11	16	16	56	195	3.48	+++++++++++++++++
96	5	9	4	13	9	18	53	182	3.43	+++++++++++++++++
97	7	16	4	12	11	8	51	144	2.82	++++++++++++++
98	4	8	4	13	16	13	54	184	3.41	+++++++++++++++++

COMPETENCY NUMBER	RESPONSE RATINGS 0	1	2	3	4	5	TOTAL RESPONSES	TOTAL SCORE	AVERAGE SCORE	AVERAGE SCORE CHART
99	4	8	2	9	19	16	54	195	3.61	++++++++++++++++++
100	6	19	7	8	8	10	52	139	2.67	+++++++++++++
101	5	14	9	8	6	16	53	160	3.02	+++++++++++++++
102	8	16	12	7	3	12	50	133	2.66	+++++++++++++
103	6	20	11	5	4	12	52	133	2.56	++++++++++++
104	5	15	9	11	9	9	53	147	2.77	+++++++++++++
105	5	14	7	9	11	12	53	159	3.00	+++++++++++++++
106	5	16	6	14	9	8	53	146	2.75	+++++++++++++
107a	3	6	4	11	14	20	55	203	3.69	++++++++++++++++++
107b	3	9	5	10	13	18	55	191	3.47	+++++++++++++++++
107c	10	14	1	9	9	15	48	154	3.21	++++++++++++++++
108	10	30	4	10	2	2	48	86	1.79	++++++++
109	11	20	8	10	4	5	47	107	2.28	+++++++++++
110a	8	13	11	8	8	10	50	141	2.82	++++++++++++++
110b	8	13	11	7	9	10	50	142	2.84	++++++++++++++
110c	10	15	8	6	6	13	48	138	2.88	++++++++++++++
111	8	12	13	5	7	13	50	146	2.92	++++++++++++++
112a	7	14	10	9	6	12	51	145	2.84	++++++++++++++
112b	11	8	11	10	9	9	47	141	3.00	+++++++++++++++
113a	5	6	14	10	8	15	53	171	3.23	++++++++++++++++
113b	6	14	16	9	5	8	52	133	2.56	++++++++++++
114	3	12	12	16	7	8	55	152	2.76	+++++++++++++
115	6	9	7	12	4	20	52	175	3.37	++++++++++++++++
116	9	21	9	9	1	9	49	115	2.35	+++++++++++
117	9	15	6	10	6	12	49	141	2.88	++++++++++++++
118	9	24	11	5	4	5	49	102	2.08	++++++++++
119	7	18	7	11	7	8	51	133	2.61	+++++++++++++
120	1	3	5	9	15	25	57	225	3.95	+++++++++++++++++++

Generic Curriculum Model

The generic curriculum design which follows is based on the validated competencies and the CORD curriculum model for telecommunications technology. The project staff first developed a conceptual model of the telecommunications technology. This model, presented below, includes a breakdown of the major telecommunications topics and the specialty fields within the industry.


TELECOMMUNICATIONS
ANALOG
DIGITAL
CABLE
RADIO FREQUENCY
MICRO-WAVE
LIGHT
DATA (MODEM)
VOICE
IMAGERY
VOICE
IMAGERY
DATA
SWITCHING METHODS
ANTENNA
TRANSMISSION

This activity was followed by developing a generic model competency course matrix. This matrix, presented on pages 24 - 43 was patterned after the CORD curriculum model, and includes basic core, technical core and specialty courses which would be considered for inclusion in an Associate Degree program in Telecommunications Technology. In addition, the matrix shows the validated job competencies which would apply to each course. Course descriptions are presented in Appendix 10.

Then, model competency matrices were developed for the TSTI-Sweetwater and North Harris county College Telecommunications Technology programs. These matrices are shown in Appendices 14 and 15.

Generic Curriculum
Competency versus Course Matrix

JOB COMPETENCIES	BASIC CORE										TECHNICAL CORE							
TELECOMMUNICATIONS TECHNICIANS	ALGEBRA	TRIG.	GEOMETRY/ CALC.	UTC PHYSICS I	UTC PHYSICS II	UTC PHYSICS III	TECHNICAL COMMUNICATIONS	COMPUTER BASICS	ECONOMICS IN TECHNOLOGY	HUMAN RELATIONS	GRAPHICS	PROPERTIES OF MATERIALS	MECHANICAL DEVICES AND SYSTEMS	FLUID POWER	INSTRUMENTATION & CONTROLS	COMPUTER APPLICATIONS	INDUSTRIAL ELECTRICAL POWER AND EQUIPMENT	ELECTRO MECHANICAL DEVICES
1. Solve network problems using Kirchhoff, Thevenin, Norton, Superposition and Delta-Wye theorems.				x	x	x									x			
2. Set up instrumentation and measure a given voltage, current, resistance, power, and/or frequency using the appropriate VOM, DMM, oscilloscope, and/or frequency analyzer.				x	x	x												
3. Analyze, construct, and/or troubleshoot: a. Series parallel circuits b. Bridge circuits				x	x	x												
4. Troubleshoot, install, repair, and/or replace electronic circuits to the: a. Device level b. Board level c. Component level																		
5. Analyze, construct, and/or troubleshoot series, parallel, or complex: a. RLC circuits b. Resonant circuits c. Filter circuits d. Polyphase circuits e. Amplifiers and equalization networks																	x	
6. Set up and operate: a. Frequency counters b. Signal generators c. Capacitor-inductor analyzers d. Impedance bridges e. Oscilloscopes f. Sweep generators g. Spectrum analyzers h. Cable-fault analyzer				x x	x x	x x												
7. Analyze, construct, measure characteristics of, and troubleshoot: a. Diode circuits b. Transistor circuits c. FET circuits d. Thyristor circuits e. SCRs f. TRIACs g. DIACs h. Light-emitting/detecting semiconductors																		
8. Set up and use: a. Curve tracers b. Logic probes c. Logic analyzers d. Transistor testers																		
9. Analyze, construct, and troubleshoot: a. Single-stage amplifiers b. Multistage amplifiers c. Power supplies d. Oscillators																		

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	FUNDAMENTALS OF ELECTRICITY & ELECTRONICS	ANALOG SYSTEMS & DEVICES	DIGITAL ELECTRONICS	DIGITAL SYSTEMS & DEVICES	SPECIALTY AREAS			
					TELEPHONE SYSTEMS	ANALOG SYSTEMS	DIGITAL SYSTEMS	TRANSMISSION SYSTEMS
1. Solve network problems using Kirchhoff, Thevenin, Norton, Superposition and Delta-Wye theorems.	x							
2. Set up instrumentation and measure a given voltage, current, resistance, power, and/or frequency using the appropriate VOM, DMM, oscilloscope, and/or frequency analyzer.	x							
3. Analyze, construct, and/or troubleshoot:								
a. Series-parallel circuits	x		x					
b. Bridge circuits	x							
4. Troubleshoot, install, repair, and/or replace electronic circuits to the:								
a. Device level			x	x	x		x	x
b. Board level			x	x	x		x	x
c. Component level			x	x	x		x	x
5. Analyze, construct, and/or troubleshoot series, parallel, or complex:								
a. RLC circuits	x							
b. Resonant circuits	x							
c. Filter circuits			x					
d. Polyphase circuits	x							
e. Amplifiers and equalization networks			x					
6. Set up and operate:								
a. Frequency counters		x	x					
b. Signal generators	x	x	x					
c. Capacitor-inductor analyzers			x					
d. Impedance bridges			x					x
e. Oscilloscopes								
f. Sweep generators			x					x
g. Spectrum analyzers								x
h. Cable-fault analyzer								x
7. Analyze, construct, measure characteristics of, and troubleshoot:								
a. Diode circuits	x							
b. Transistor circuits	x							
c. FET circuits	x							
d. Thyristor circuits	x							
e. SCRs	x							
f. TRIACs	x							
g. DIACs	x							
h. Light emitting/detecting semiconductors	x		x	x				
8. Set up and use:								
a. Curve tracers							x	
b. Logic probes		x		x			x	
c. Logic analyzers		x		x			x	
d. Transistor testers	x							
9. Analyze, construct, and troubleshoot:								
a. Single-stage amplifiers			x			x		
b. Multistage amplifiers			x			x		
c. Power supplies	x					x		
d. Oscillators			x			x		

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	BASIC CORE										TECHNICAL CORE							
	ALGEBRA	TRIG.	GEOMETRY/ CALC.	UTC PHYSICS I	UTC PHYSICS II	UTC PHYSICS III	TECHNICAL COMMUNICATIONS	COMPUTER BASICS	ECONOMICS IN TECHNOLOGY	HUMAN RELATIONS	GRAPHICS	PROPERTIES OF MATERIALS	MECHANICAL DEVICES AND SYSTEMS	FLUID POWER	INSTRUMENTATION & CONTROLS	COMPUTER APPLICATIONS	INDUSTRIAL ELECTRICAL POWER AND EQUIPMENT	ELECTRO-MECHANICAL DEVICES
10. Analyze, troubleshoot, and repair advanced servomechanism systems.																		x
11. Read and sketch electronic schematics.											x							
12. Record data and design curves and graphs.							x				x							
13. State input and output speed, voltage and current characteristics of ten logic families and RS232C devices.																x		
14. Identify electrical problems encountered when interfacing between logic families and RS232C devices.																x		
15. Build and test interfaces between TTL and CMOS circuits.																		
16. Given a standard specification, determine whether or not a representative of any of the following logic circuits is operational:																		
a. Gate, buffer/driver																x		
b. Buffer/driver																x		
c. Flip-flop																x		
d. Counter, shift register																x		
e. Selector																x		
f. Multiplexer/demultiplexer																x		
g. Comparator																x		
17. Explain the role of timing in communication; distinguish between synchronous and asynchronous transmission.																		
18. Describe capacity of a channel in terms of bandwidth, baud-rate and grade.																		
19. Describe communication made possible by simplex, half-duplex and duplex links.																		
20. Use a shift register as a digital multiplexer and as a demultiplexer.																x		
21. Use an analog switch as an analog multiplexer and as a demultiplexer.																		
22. Build a digital and an analog multiplexed data communication system; use each system to communicate information.																x		
23. Identify microcomputer ICs and determine function and logic from manual.																		
24. Locate source of static hardware difficulties in small microcomputer systems.																x		
25. Use logic analyzer for dynamic testing of microcomputer sys																x		

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	FUNDAMENTALS OF ELECTRICITY & ELECTRONICS	ANALOG SYSTEMS & DEVICES	DIGITAL ELECTRONICS	DIGITAL SYSTEMS & DEVICES	SPECIALTY AREAS			
					TELEPHONE SYSTEMS	ANALOG SYSTEMS	DIGITAL SYSTEMS	TRANSMISSION SYSTEMS
10. Analyze, troubleshoot, and repair advanced servomechanism systems.							x	
11. Read and sketch electronic schematics.	x							
12. Record data and design curves and graphs.					x		x	
13. State input and output speed, voltage and current characteristics of ten logic families and RS232C devices.		x		x			x	
14. Identify electrical problems encountered when interfacing between logic families and RS232C devices.			x	x			x	
15. Build and test interfaces between TTL and CMOS circuits.		x		x				
16. Given a standard specification, determine whether or not a representative of any of the following logic circuits is operational:								
a. Gate, buffer/driver		x		x			x	
b. Buffer/driver		x		x			x	
c. Flip-flop		x		x			x	
d. Counter, shift register		x		x			x	
e. Selector		x		x			x	
f. Multiplexer/demultiplexer		x		x			x	
g. Comparator		x					x	
17. Explain the role of timing in communication; distinguish between synchronous and asynchronous transmission.				x		x	x	
18. Describe capacity of a channel in terms of bandwidth, baud-rate and grade.						x	x	x
19. Describe communication made possible by simplex, half-duplex and duplex links.						x	x	
20. Use a shift register as a digital multiplexer and as a demultiplexer.				x			x	
21. Use an analog switch as an analog multiplexer and as a demultiplexer.			x				x	x
22. Build a digital and an analog multiplexed data communication system; use each system to communicate information.			x	x		x	x	
23. Identify microcomputer ICs and determine function and logic from manual.		x		x				
24. Locate source of static hardware difficulties in small microcomputer systems.							x	
25. Use logic analyzer for dynamic testing of microcomputer systems.				x			x	

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	BASIC CORE										TECHNICAL CORE							
	ALGEBRA	TRIG.	GEOMETRY/ CALC.	UTC PHYSICS I	UTC PHYSICS II	UTC PHYSICS III	TECHNICAL COMMUNICATIONS	COMPUTER BASICS	ECONOMICS IN TECHNOLOGY	HUMAN RELATIONS	GRAPHICS	PROPERTIES OF MATERIALS	MECHANICAL DEVICES AND SYSTEMS	FLUID POWER	INSTRUMENTATION & CONTROLS	COMPUTER APPLICATIONS	INDUSTRIAL ELECTRICAL POWER AND EQUIPMENT	ELECTRO-MECHANICAL DEVICES
26. Analyze, troubleshoot, and repair: a. ECL logic families b. LSI circuits																* *		
27. Analyze and troubleshoot firmware using defined hardware.																		
28. Analyze, construct, troubleshoot: a. CPUs b. BUS systems c. Memory systems d. Input/output ports																* * * *		
29. Analyze, construct and troubleshoot microprocessor applications and systems.																*		
30. Analyze and troubleshoot microcomputer systems.																*		
31. Breadboard A/D and D/A circuits.																		
32. Interface a specified microprocessor to an input/output measurement system.																*		
33. Construct or install: a. Station (JKT, UBOC blocks, 25-pair cable, colors) b. Jumper wires c. Punch-down techniques																		
34. Repair and/or replace: a. Station (JKT, UBOC blocks, 25-pair cable, colors) b. Jumper wires c. Punch-down techniques																		
35. Read and interpret: a. Attached and detached contact schematics b. T-drawings c. Office drawings																		
36. Define and give standard examples using the terms: a. Baud b. Modem c. PBX								* * *								* * *		
37. Identify the tone-pair assignments for: a. DTMF b. MF																		
38. Identify and describe the differences between the five classes of telephone offices.																		
39. Discuss the various multiplexing methods employed in telephony systems.																		
40. Identify the frequency allocations for RF energy as governed by: a. ITU b. FCC																		

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS					SPECIALTY AREAS			
	FUNDAMENTALS OF ELECTRICITY & ELECTRONICS	ANALOG SYSTEMS & DEVICES	DIGITAL ELECTRONICS	DIGITAL SYSTEMS & DEVICES	TELEPHONE SYSTEMS	ANALOG SYSTEMS	DIGITAL SYSTEMS	TRANSMISSION SYSTEMS
26. Analyze, troubleshoot, and repair:								
a. ECL logic families				x				
b. LSI circuits				x				
27. Analyze and troubleshoot firmware using defined hardware.								
28. Analyze, construct, troubleshoot:								
a. CPUs					x		x	
b. BUS systems					x		x	
c. Memory systems					x		x	
d. Input/output ports					x		x	
29. Analyze, construct and troubleshoot microprocessor applications and systems.							x	
30. Analyze and troubleshoot microcomputer systems.							x	
31. Breadboard A/D and D/A circuits.						x	x	
32. Interface a specified microprocessor to an input/output measurement system.						x	x	
33. Construct or install:								
a. Station (JKT, USOC blocks, 25-pair cable, colors)					x			
b. Jumper wires					x			
c. Punch-down techniques					x			
34. Repair and/or replace:								
a. Station (JKT, USOC blocks, 25-pair cable, colors)					x			
b. Jumper wires					x			
c. Punch-down techniques					x			
35. Read and interpret:								
a. Attached and detached contact schematics					x			
b. T-drawings					x			
c. Office drawings					x			
36. Define and give standard examples using the terms:								
a. Baud					x		x	
b. Modem					x	x	x	
c. PBX					x	x	x	
37. Identify the tone-pair assignments for:								
a. DTMF					x			x
b. MF					x			x
38. Identify and describe the differences between the five classes of telephone offices.					x			x
39. Discuss the various multiplexing methods employed in telephony systems.					x	x	x	x
40. Identify the frequency allocations for RF energy as governed by:								
a. ITU								x
b. FCC								x

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	BASIC CORE										TECHNICAL CORE							
	ALGEBRA	TRIG.	GEOMETRY/ CALC.	UTC PHYSICS I	UTC PHYSICS II	UTC PHYSICS III	TECHNICAL COMMUNICATIONS	COMPUTER BASICS	ECONOMICS IN TECHNOLOGY	HUMAN RELATIONS	GRAPHICS	PROPERTIES OF MATERIALS	MECHANICAL DEVICES AND SYSTEMS	FLUID POWER	INSTRUMENTATION & CONTROLS	COMPUTER APPLICATIONS	INDUSTRIAL ELECTRICAL POWER AND EQUIPMENT	ELECTRO-MECHANICAL DEVICES
41. Match frequency ranges to banks (VLF, LF, MF, HF, VHF, UHF, and SHF).																		
42. Identify and translate messages in the codes:																		
a. Q-signals																		
b. 10-code																		
c. Baudot 5-bit code																		
d. ASCII 7/8 bit code								*								*		
e. EBCDIC								*								*		
43. Set up and measure:																		
a. VSWR																		
b. Attenuation																		
c. Insertion loss																		
44. Troubleshoot and replace:																		
a. Klystron tubes																		
b. TWTs																		
c. Magnetrons																		
d. Varactors																		
e. Gunn diodes																		
f. Tunnel diodes																		
g. Step-recovery diodes																		
h. YIG tuned																		
45. Identify, set up, tune and test waveguide transmission lines.																		
46. Troubleshoot, repair and/or replace transmission-line sections.																		
47. Use Smith chart for impedance calculations with transmission lines.																		
48. Select, set up, connect, troubleshoot and repair the following antennas:																		
a. Monopole																		
b. Dipole																		
c. Folded dipole																		
d. Logarithmically periodic																		
e. Conical																		
f. Helical																		
g. Loop																		
h. Rhombic																		
i. Slot																		
j. Horn																		
49. Describe signal propagation effects for antennas with respect to reflector elements and parasitic elements.																		
50. Troubleshoot:																		
a. HF transmitters																		
b. HF receivers																		
c. Single-sideband transceiver																		
d. With the two-tone test																		
51. Repair and align:																		
a. Linear amplifiers																		
b. Video transmission equipment																		
52. Measure, align and test:																		
a. SSB/CW/AM receiver performance																		
b. Microwave lines																		
c. FM transmitter																		

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	FUNDAMENTALS OF ELECTRICITY & ELECTRONICS	ANALOG SYSTEMS & DEVICES	DIGITAL ELECTRONICS	DIGITAL SYSTEMS & DEVICES	SPECIALTY AREAS TELEPHONE SYSTEMS	ANALOG SYSTEMS	DIGITAL SYSTEMS	TRANSMISSION SYSTEMS
41. Match frequency ranges to bands (VLF, LF, MF, HF, VHF, UHF, and SHF).								x
42. Identify and translate messages in the codes:								
a. Q-signals						x		
b. 10-code						x		
c. Baudot 5-bit code							x	
d. ASCII 7/8 bit code							x	
e. EBCDIC							x	
43. Set up and measure:								
a. VSWR								x
b. Attenuation								x
c. Insertion loss								x
44. Troubleshoot and replace:								
a. Klystron tubes			x			x		
b. TWTs			x			x		
c. Magnetrons			x			x		
d. Varactors			x			x		
e. Gunn diodes			x			x		
f. Tunnel diodes			x			x		
g. Step-recovery diodes			x			x		
h. YIG tuned			x			x		
45. Identify, set up, tune and test waveguide transmission lines.								x
46. Troubleshoot, repair and/or replace transmission-line sections.								x
47. Use Smith chart for impedance calculations with transmission lines.								x
48. Select, set up, connect, troubleshoot and repair the following antennas:								
a. Monopole								x
b. Dipole								x
c. Folded dipole								x
d. Logarithmically periodic								x
e. Conical								x
f. Helical								x
g. Loop								x
h. Rhombic								x
i. Slot								x
j. Horn								
49. Describe signal propagation effects for antennas with respect to reflector elements and parasitic elements.								x
50. Troubleshoot:								
a. HF transmitters						x		
b. HF receivers						x		
c. Single-sideband transceiver						x		
d. With the two-tone test						x		
51. Repair and align:								
a. Linear amplifiers						x		
b. Video transmission equipment						x		
52. Measure, align and test:								
a. SSB/CW/AM receiver performance						x		
b. Microwave lines								x
c. FM transmitter						x		

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	BASIC CORE										TECHNICAL CORE							
	ALGEBRA	TRIG.	GEOMETRY/CALC.	UTC PHYSICS I	UTC PHYSICS II	UTC PHYSICS III	TECHNICAL COMMUNICATIONS	COMPUTER BASICS	ECONOMICS IN TECHNOLOGY	HUMAN RELATIONS	GRAPHICS	PROPERTIES OF MATERIALS	MECHANICAL DEVICES AND SYSTEMS	FLUID POWER	INSTRUMENTATION & CONTROLS	COMPUTER APPLICATIONS	INDUSTRIAL ELECTRICAL POWER AND EQUIPMENT	ELECTROMECHANICAL DEVICES
53. Analyze frequency synthesizers: a. PLL type b. LSI type																		
54. Perform or check calibration of: a. Test instrument meters b. Frequency counters c. Spectrum analyzers																		
55. For optical fibers measure: a. Transmission loss b. Scattering and absorption loss c. Accuracy d. Length (via reflectometry methods) e. Spectral attenuation f. Frequency response g. Refractive index profile h. Impulse response																		
56. Splice optical fibers where/when required.																		
57. Use connectors for alignment and coupling of light source into fiber.																		
58. Install, troubleshoot, and replace: a. LED light sources b. Solid-state lasers c. Electro-optic modulators d. Acousto-optic devices e. Photodetectors																		
59. Recognize resistor values using the standard resistor color code and identify different types of resistors such as thermistors, voltage-dependent resistors, variable resistors and others.																		
60. Recognize and test common electronic components such as capacitors and inductors, and determine their values by common markings.																		
61. Determine power, impedance, admittance, susceptance and other applicable values of complex series and/or parallel R-C-L Circuits.																		
62. Analyze dc and ac motors and generators.																	▪	▪
63. Identify/name families of linear and logic integrated circuits.																		

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	FUNDAMENTALS OF ELECTRICITY & ELECTRONICS	ANALOG SYSTEMS & DEVICES	DIGITAL ELECTRONICS	DIGITAL SYSTEMS & DEVICES	SPECIALTY AREAS			
					TELEPHONE SYSTEMS	ANALOG SYSTEMS	DIGITAL SYSTEMS	TRANSMISSION SYSTEMS
53. Analyze frequency synthesizers:								
a. PLL type						x	x	
b. LSI type							x	
54. Perform or check calibration of:								
a. Test instrument meters			x	x				
b. Frequency counters			x	x		x	x	
c. Spectrum analyzers			x	x		x	x	x
55. For optical fibers measure:								
a. Transmission loss								x
b. Scattering and absorption loss								x
c. Accuracy								x
d. Length (via reflectometry methods)								x
e. Spectral attenuation								x
f. Frequency response								x
g. Refractive index profile								x
h. Impulse response								x
56. Splice optical fibers where/when required.								x
57. Use connectors for alignment and coupling of light source into fiber.								x
58. Install, troubleshoot, and replace:								
a. LED light sources		x						x
b. Solid-state lasers								x
c. Electro-optic modulators								x
d. Acousto-optic devices								
e. Photodetectors		x						x
59. Recognize resistor values using the standard resistor color code and identify different types of resistors such as thermistors, voltage-dependent resistors, variable resistors and others.	x							
60. Recognize and test common electronic components such as capacitors and inductors, and determine their values by common markings.	x							
61. Determine power, impedance, admittance, susceptance and other applicable values of complex series and/or parallel R-C-L Circuits.	x							
62. Analyze dc and ac motors and generators.								
63. Identify/name families of linear and logic integrated circuits.		x		x				

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	BASIC CORE										TECHNICAL CORE							
	ALGEBRA	TRIG.	GEOMETRY/ CALC.	UTC PHYSICS I	UTC PHYSICS II	UTC PHYSICS III	TECHNICAL COMMUNICATIONS	COMPUTER BASICS	ECONOMICS IN TECHNOLOGY	HUMAN RELATIONS	GRAPHICS	PROPERTIES OF MATERIALS	MECHANICAL DEVICES AND SYSTEMS	FLUID POWER	INSTRUMENTATION & CONTROLS	COMPUTER APPLICATIONS	INDUSTRIAL ELECTRICAL POWER AND EQUIPMENT	ELECTRO-MECHANICAL DEVICES
64. Analyze function and operation, construct, measure, and troubleshoot commonly used semiconductor circuits.																		
a. Power supplies																		
b. AF/RF amplifiers																		
c. AF/RF oscillators, generators, clocks																		
d. Wave-shaping circuits																		
e. Filters																		
65. Demonstrate knowledge of:																		
a. Drafting techniques											x							
b. Lettering procedures											x							
c. Use of drafting instruments											x							
66. Identify and classify items as being either analog or digital in nature.																		
67. Convert between binary, octal, hexadecimal, decimal and BCD number systems.																		
68. Analyze, design and troubleshoot digital circuits using logic gates and flip-flops.																		
69. Use Boolean algebra to express logic operations.																		
70. Given a standard specification, determine whether or not a representative of any of the following logic circuits is operational:																		
a. Gate, buffer/driver																		
b. Buffer/driver																		
c. Flip-flop																		
d. Counter, shift register																		
e. Multiplexer/demultiplexer																		
f. Comparator																		
71. Analyze, construct and troubleshoot sequential logic circuits such as binary and BCD counters and shift registers.																		
72. Identify, analyze and troubleshoot various types of semiconductor memories: RAMs, ROMs, etc.																x		
73. Analyze and troubleshoot various types of data convertors.																x		
74. Build and test interfaces between TTL and CMOS circuits.																		
75. Analyze, construct, troubleshoot:																		
a. Memory systems and address decoders																x		
b. Input/output ports																x		
c. A to D and D to A convertors																x		

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS					SPECIALTY AREAS			
	FUNDAMENTALS OF ELECTRICITY & ELECTRONICS	ANALOG SYSTEMS & DEVICES	DIGITAL ELECTRONICS	DIGITAL SYSTEMS & DEVICES	TELEPHONE SYSTEMS	ANALOG SYSTEMS	DIGITAL SYSTEMS	TRANSMISSION SYSTEMS
64. Analyze function and operation, construct, measure, and troubleshoot commonly used semiconductor circuits.								
a. Power supplies	x					x		
b. AF/RF amplifiers						x		
c. AF/RF oscillators, generators, clocks						x		
d. Wave-shaping circuits			x			x		
e. Filters						x		
65. Demonstrate knowledge of:								
a. Drafting techniques								
b. Lettering procedures								
c. Use of drafting instruments								
66. Identify and classify items as being either analog or digital in nature.			x	x	x	x	x	
67. Convert between binary, octal, hexadecimal, decimal and BCD number systems.		x					x	
68. Analyze, design and troubleshoot digital circuits using logic gates and flip-flops.		x		x				
69. Use Boolean algebra to express logic operations.		x						
70. Given a standard specification, determine whether or not a representative of any of the following logic circuits is operational:								
a. Gate, buffer/driver		x						
b. Buffer/driver		x						
c. Flip-flop		x						
d. Counter, shift register		x						
e. Multiplexer/demultiplexer		x				x	x	x
f. Comparator		x						
71. Analyze, construct and troubleshoot sequential logic circuits such as binary and BCD counters and shift registers.		x						
72. Identify, analyze and troubleshoot various types of semiconductor memories: RAMs, ROMs, etc.	x	x						
73. Analyze and troubleshoot various types of data convertors.				x			x	
74. Build and test interfaces between TTL and CMOS circuits.				x				
75. Analyze, construct, troubleshoot:								
a. Memory systems and address decoders				x			x	
b. Input/output ports				x			x	
c. A to D and D to A convertors				x		x	x	

	BASIC CORE										TECHNICAL CORE							
JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	ALGEBRA	TRIG.	GEOMETRY/ CALC.	UTC PHYSICS I	UTC PHYSICS II	UTC PHYSICS III	TECHNICAL COMMUNICATIONS	COMPUTER BASICS	ECONOMICS IN TECHNOLOGY	HUMAN RELATIONS	GRAPHICS	PROPERTIES OF MATERIALS	MECHANICAL DEVICES AND SYSTEMS	FLUID POWER	INSTRUMENTATION & CONTROLS	COMPUTER APPLICATIONS	INDUSTRIAL ELECTRICAL POWER AND EQUIPMENT	ELECTRO-MECHANICAL DEVICES
76. Construct, analyze and troubleshoot circuits containing operational amplifiers.																		
77. Measure and compute common OP-AMP parameters.																		
78. Discuss optical terms and concepts related to lasers and fiber optics.																		
79. Recognize safety hazards associated with all types of lasers.																		
80. Draw dc and ac signal paths on electronic block diagrams, schematics, and printed circuit board layouts.																		
81. Design PC board layouts from schematics.																		
82. Construct PC boards using manual artwork, dry transfer on copper-clad board, and photographic methods.																		
83. Troubleshoot, install, repair, and/or replace electronic circuits on PC boards at component level.																		
84. Protect PC board by tin plating and by using chemical sprays.																		
85. Repair damaged PC board lands.																		
86. Discuss and demonstrate image systems, capture, processing and display.																		
87. Analyze, configure, troubleshoot and repair the following systems: a. Vidicon and CCD cameras b. Video monitors c. Video LCD displays d. Video scanners																		
88. Analyze and test digital video processors.																		
89. Analyze, troubleshoot and repair various video recorders.																		
90. Discuss and test digital recorders.																		
91. Process, manipulate and convert various image formats.																		
92. Construct and test basic CW transmitter.																		
93. Construct basic receiver to detect AM, SSB, and FM.																		
94. Analyze transmitted signals in both the time and frequency domains.																		

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	FUNDAMENTALS OF ELECTRICITY & ELECTRONICS	ANALOG SYSTEMS & DEVICES	DIGITAL ELECTRONICS	DIGITAL SYSTEMS & DEVICES	SPECIALTY AREAS TELEPHONE SYSTEMS	ANALOG SYSTEMS	DIGITAL SYSTEMS	TRANSMISSION SYSTEMS
76. Construct, analyze and troubleshoot circuits containing operational amplifiers.			•					
77. Measure and compute common OP-AMP parameters.			•					
78. Discuss optical terms and concepts related to lasers and fiber optics.					•			•
79. Recognize safety hazards associated with all types of lasers.								•
80. Draw dc and ac signal paths on electronic block diagrams, schematics, and printed circuit board layouts.	•	•	•	•				
81. Design PC board layouts from schematics.	•							
82. Construct PC boards using manual artwork, dry transfer on copper clad board, and photographic methods.	•							
83. Troubleshoot, install, repair, and/or replace electronic circuits on PC boards at component level.	•							
84. Protect PC board by tin plating and by using chemical sprays.	•							
85. Repair damaged PC board lands.	•							
86. Discuss and demonstrate image systems, capture, processing and display.						•	•	
87. Analyze, configure, troubleshoot and repair the following systems:								
a. Videcon and CCD cameras						•		
b. Video monitors						•		
c. Video LCD displays						•		
d. Video scanners						•		
88. Analyze and test digital video processors.							•	
89. Analyze, troubleshoot and repair various video recorders.						•	•	
90. Discuss and test digital recorders.				•			•	
91. Process, manipulate and convert various image formats.						•	•	
92. Construct and test basic CW transmitter.						•		
93. Construct basic receiver to detect AM, SSB, and FM.						•		
94. Analyze transmitted signals in both the time and frequency domains.				•		•	•	

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	BASIC CORE										TECHNICAL CORE							
	ALGEBRA	TRIG.	GEOMETRY/ CALC.	UTC PHYSICS I	UTC PHYSICS II	UTC PHYSICS III	TECHNICAL COMMUNICATIONS	COMPUTER BASICS	ECONOMICS IN TECHNOLOGY	HUMAN RELATIONS	GRAPHICS	PROPERTIES OF MATERIALS	MECHANICAL DEVICES AND SYSTEMS	FLUID POWER	INSTRUMENTATION & CONTROLS	COMPUTER APPLICATIONS	INDUSTRIAL ELECTRICAL POWER AND EQUIPMENT	ELECTRO-MECHANICAL DEVICES
95. Measure output power by direct and indirect methods.																		
96. Measure signal, sensitivity, selectivity and signal-to-noise ratio in receivers.																		
97. Analyze frequency synthesizers.																		
98. Identify and analyze a variety of common types of coaxial transmission lines with respect to physical construction, impedance, velocity factor and line loss.																		
99. Identify, install and test common types of coaxial connectors.																		
100. Discuss AM and FM broadcast systems, classifications, power, components, interconnects, antenna systems, tests and logs.																		
101. Demonstrate technical proficiency regarding trouble-shooting, tuning, power measurements, studio and transmitter maintenance, proof of performance tests and FCC requirements.																		
102. Analyze and demonstrate thorough knowledge of various network, STL, and satellite interconnects and levels.																		
103. Demonstrate satisfactory ability to operate test equipment associated with broadcast.																		
104. Discuss and perform calculations required for microwave transmission.																		
105. Operate, tune and adjust microwave sources.																		
106. Calculate microwave antenna parameters.																		
107. Measure and record the following: a. Power and frequency b. Receive carrier levels c. Deviation using bessel null function																		
108. Exhibit proficiency in radar operation and testing.																		
109. Orient and test both azel and polar-mount satellite antennas.																		

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	FUNDAMENTALS OF ELECTRICITY & ELECTRONICS	ANALOG SYSTEMS & DEVICES	DIGITAL ELECTRONICS	DIGITAL SYSTEMS & DEVICES	SPECIALTY AREAS TELEPHONE SYSTEMS	ANALOG SYSTEMS	DIGITAL SYSTEMS	TRANSMISSION SYSTEMS
95. Measure output power by direct and indirect methods.						*	*	*
96. Measure signal, sensitivity, selectivity and signal-to-noise ratio in receivers.						*		*
97. Analyze frequency synthesizers.		*						*
98. Identify and analyze a variety of common types of coaxial transmission lines with respect to physical construction, impedance, velocity factor and line loss.								*
99. Identify, install and test common types of coaxial connectors.								*
100. Discuss AM and FM broadcast systems, classifications, power, components, interconnects, antenna systems, tests and logs.						*		*
101. Demonstrate technical proficiency regarding trouble-shooting, tuning, power measurements, studio and transmitter maintenance, proof of performance tests and FCC requirements.						*		*
102. Analyze and demonstrate thorough knowledge of various network, STL, and satellite interconnects and levels.								*
103. Demonstrate satisfactory ability to operate test equipment associated with broadcast.			*	*		*	*	*
104. Discuss and perform calculations required for microwave transmission.								*
105. Operate, tune and adjust microwave sources.						*		*
106. Calculate microwave antenna parameters.								*
107. Measure and record the following: a. Power and frequency b. Receive carrier levels c. Deviation using bessel null function						* *	* *	* * *
108. Exhibit proficiency in radar operation and testing.						*		*
109. Orient and test both azel and polar mount satellite antennas.								*

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	BASIC CORE										TECHNICAL CORE							
	ALGEBRA	TRIG.	GEOMETRY/ CALC.	UTC PHYSICS I	UTC PHYSICS II	UTC PHYSICS III	TECHNICAL COMMUNICATIONS	COMPUTER BASICS	ECONOMICS IN TECHNOLOGY	HUMAN RELATIONS	GRAPHICS	PROPERTIES OF MATERIALS	MECHANICAL DEVICES AND SYSTEMS	FLUID POWER	INSTRUMENTATION & CONTROLS	COMPUTER APPLICATIONS	INDUSTRIAL ELECTRICAL POWER AND EQUIPMENT	ELECTROMECHANICAL DEVICES
110. Using a commercial mobile transceiver and service manual: a. Follow by drawing with color pencils the dc and ac signal tracks on block diagram, schematic, PC board layouts. b. Analyze the function of every circuit by measuring the dc and ac signals throughout the transceiver with a DVM, oscilloscope, modulated RF signal generator and frequency counter. c. Tune all stages to service manual specifications.																		
111. Analyze repeater operations. Tune and adjust PL encoder/decoder, deviation tracking and duplexers.																		
112. Analyze, set signal levels and tune: a. Tone paging, alert and control systems. b. Telephone and RF link interconnects																		
13. Analyze the operation of: a. Trunking systems b. Cellular systems																		
14. Demonstrate knowledge of rules and regulations, franchise, and copyright.									x									
15. Test, troubleshoot and repair processors, demodulators, modulators, line amplifiers (with/without AGC), extenders, and directional taps.																		
116. Set up CATV system levels, verify and log same.																		
117. Perform FCC system proof tests.																		
118. Analyze and layout small CATV plant.																		
119. Discuss types and classes of licensing, review subject material covered, take sample tests and critique same.																		
120. Demonstrate ability to understand written problems.				x	x	x												

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	FUNDAMENTALS OF ELECTRICITY & ELECTRONICS	ANALOG SYSTEMS & DEVICES	DIGITAL ELECTRONICS	DIGITAL SYSTEMS & DEVICES	SPECIALTY AREAS: TELEPHONE SYSTEMS	SPECIALTY AREAS: ANALOG SYSTEMS	SPECIALTY AREAS: DIGITAL SYSTEMS	SPECIALTY AREAS: TRANSMISSION SYSTEMS
110. Using a commercial mobile transceiver and service manual:								
a. Follow by drawing with color pencils the dc and ac signal tracks on block diagram, schematic, PC board layouts.					x	x		
b. Analyze the function of every circuit by measuring the dc and ac signals throughout the transceiver with a DMM, oscilloscope, modulated RF signal generator and frequency counter.						x		
c. Tune all stages to service manual specifications.						x		
111. Analyze repeater operations. Tune and adjust PL encoder/decoder, deviation tracking and duplexers.						x	x	
112. Analyze, set signal levels and tune:								
a. Tone paging, alert and control systems.						x	x	
b. Telephone and RF link interconnects					x	x	x	
113. Analyze the operation of:								
a. Trunking systems					x			x
b. Cellular systems					x			x
114. Demonstrate knowledge of rules and regulations, franchise, and copyright.								
115. Test, troubleshoot and repair processors, demodulators, modulators, line amplifiers (with/without AGC), extenders, and directional taps.						x	x	x
116. Set up CATV system levels, verify and log same.								x
117. Perform FCC system proof tests.						x		x
118. Analyze and layout small CATV plant.								x
119. Discuss types and classes of licensing, review subject material covered, take sample tests and critique same.						x		x
120. Demonstrate ability to understand written problems.			x	x				

Based upon input from the TSTI and NHCC faculty, the original CORD telecommunications curriculum was modified to accommodate the project generic curriculum needs. The six specialty courses were replaced by four major fields within Telecommunications. By identifying these specialty fields, schools operating on either quarter or semester systems will have a guide with which to compare their curriculum.

The four specialty fields are

- Analog communications
- Digital Communications
- Transmission systems
- Telephone Systems

By identifying the foundation courses, schools will have a model to build upon and to compare existing courses with. In addition, the four specialty fields provide guidance into a possible course breakdown of subspecialties within telecommunications. Descriptions for each course are included in Appendix 10.

The other two matrices show the relationship of NHCC and TSTI courses to the list of validated competencies. Representatives from each school have commented on the accuracy of the matrices, which are Appendices 14 and 15 to this report.

The survey results and three matrices were presented to the Advisory Committee on June 7 at NHCC. The meeting focused on the competency validation process and the construction of the competency versus generic-curriculum course matrix. The Advisory Committee's members concurred with the processes used and the method used to score the results. All members agreed that a person who completed training similar to that described by the generic curriculum would be a highly desirable employee.

Articulation with Four-year Institutions

An Associate Degree program must include 15 semester hours (24 quarter hours) of general education courses, as required by the Southern Association of Colleges and Schools. To insure the transferability of these courses to four-year institutions, use the Community College General Academic Course Guide Manual published by the Coordinating Board, Texas College and University System. The transfer curriculum for Engineering Technology is also included in the General Academic Course Guide Manual, and this curriculum should be reviewed for possible courses to include in the curriculum.

Articulation agreements with four-year institutions should be developed to insure the maximum transfer of course credits. Example articulation charts from the engineering technology departments at Texas A & M University and Texas Tech University are shown in Appendicies 16 and 17. Students who wish to tranfer must have a strong math backgound. No two-level school courses will transfer for a three level or above course at a four-year institution.

Equipment List

An equipment list which may be used to start a telecommunications technology laboratory is shown in Appendix 18.

List of References

Select textbooks and media in telecommunications technology are shown in Appendix 19.

Program Implementation

The reader is encouraged to read chapter 5 in the Telecommunication Curriculum Guide published by the Center of Occupational Research and Development. This publication includes excellent guidelines on planning and implementing a new curriculum, instructional methodology, staffing, facilities and equipment, evaluation, and analysis of program costs.

Project Evaluation

A project evaluation was performed by the advisory committee during the final advisory committee meeting. The results of this evaluation are summarized on the following page. Summary responses are highlighted.

Recommendation

Postsecondary schools should use the model generic curriculum approved by the Project Advisory Committee as a basis for developing new curricula in Telecommunications Technology or revising existing curricula.

The Coordinating Board should consider funding state-wide validations of curriculum competencies in all technical- vocational areas in which there are significant numbers of programs. This would minimize the duplication of efforts among the technical institutes and community and junior colleges.

SUMMARY
PROJECT EVALUATION

Directions: Please give your opinion on how well the Project objectives were met by reading the questions below and marking the appropriate number on the attached Scantron form. Follow this criteria in marking your response:

NOT APPLICABLE
0. Do not have the knowledge to evaluate this item
LOWEST
1. Do not feel this objective was accomplished.
2. Do not feel this objective was accomplished very well.
AVERAGE
3. Feel this objective was partially accomplished.
4. Feel this objective was accomplished well.
HIGHEST
5. Feel this objective was accomplished exceptionally well.

		No. Responses						Mean Score
						3	4	4.6
1.	Arrangement for committee meetings	0	1	2	3	4	5	
						4	3	4.4
2.	Adequacy of committee meeting presentations	0	1	2	3	4	5	
						6	1	4.1
3.	Clarity of the project objectives	0	1	2	3	4	5	
					1	5	1	4.0
4.	Time allowed for committee member input	0	1	2	3	4	5	
					1	3	3	4.3
5.	Quality of handouts during committee meetings	0	1	2	3	4	5	
						5	2	4.3
6.	Structure of committee meetings	0	1	2	3	4	5	
					1	4	2	4.1
7.	Ability of committee to represent broadly the telecommunications industry.	0	1	2	3	4	5	
						4	3	4.4
8.	Quality of generic curriculum resulting from the project work	0	1	2	3	4	5	
						3	4	4.6
9.	Extent to which the generic curriculum meets industry needs.	0	1	2	3	4	5	
						2	5	4.7
10.	Extent to which the task (competency) list addresses industry skill needs	0	1	2	3	4	5	
						2	5	4.7
11.	Extent to which the final report will assist schools in setting up or revising telecommunications technology programs.	0	1	2	3	4	5	

What improvements would you suggest in the way the project was conducted?

State your instruments used up front (i.e. surveys). It wasn't until second meeting that your direction became known.

APPENDIX 1

TELECOMMUNICATIONS TECHNOLOGY PROJECT STAFF

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APPENDIX 2

JOINT ADVISORY COMMITTEE FOR TELECOMMUNICATIONS TECHNOLOGY NORTH HARRIS COUNTY COLLEGE

TSTI-SWEETWATER

ADVISORY COMMITTEE 1988

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APPENDIX 3

TSTI-SWEETWATER SUBCONTRACT

WITH

NORTH HARRIS COUNTY COLLEGE (NHCC)

Generic Curriculum Development for Telecommunications Project

1. Amount of contract: $15,000

2. General condition of contract:

   a. TSTI-Sweetwater will act as the principal developer through the validation of the curriculum elements (competencies) and the curriculum design format.
   b. NHCC will be the principal developer via contract for the curriculum design.
   c. TSTI will be responsible for the midterm and final report.

3. Specific conditions of contract:

   NHCC shall:

   a. Provide TSTI-Sweetwater with a detailed budget for NHCC's part of the project. The budget for the contract amount ($15,000) will include $1,500 for travel.
   b. Provide TSTI-Sweetwater with a list (names, addresses, and telephone numbers) of at least six county representatives to serve on the Project Advisory Committee.
   c. Meet on two occasions with the TSTI-Sweetwater project staff to plan the project.
   d. Meet on two occasions with the Project Advisory Committee and TSTI-Sweetwater staff to review/validate the curriculum.

   TSTI-Sweetwater shall:

   a. Issue a check for $15,000 to NHCC upon receipt of a detailed budget.
   b. Provide overall direction/leadership for the project.

Dean of Instruction
TSTI-Sweetwater

Executive Director, Occupational,
Technical and Continuing Education
North Harris County College

APPENDIX 4

AGREEMENT FOR THE PERFORMANCE OF INDEPENDENT CONTRACTOR

(All areas of this form must be completed prior to commitment)

Date: April 13, 1988 Budget Acct. No. 0.DT.72.10.88.635 ~~0.DC.70.50.88.635~~

1. a. Name: Center for Occupational Research & Development b. FICE ~~Soc. Sec.~~ No. 74-2077794-2

c. Address 601C Lake Air Drive City Waco State TX Zip 76710

d. Dates services are to be performed: March 29, 1988 to May 31, 1988

e. Detail description of services and place to be performed:

See Attachment A.

f. Professional affiliation of person rendering service: Title, Company, Special Credentials, etc.

Center for Occupational Research and Development

Daniel M. Hull, President

g. Fee is calculated at $_____ per _____ = Total Fee $10,000.00

h. Payment will be made **upon receipt of invoice:**

___ At the completion of all services. X At the attached designated intervals

i. AGREEMENT of Independent Contractor; I agree to perform the services described above at the rate indicated. The consideration to be paid Consultant, as provided herein, shall be in compensation for all of Consultant's expenses incurred in the performance hereof, including travel and per diem, unless otherwise expressly so provided. I understand that I am not an employee of North Harris County College because I follow an independent trade or profession, and will not be subject to control and direction as to the details and means for accomplishing the anticipated result of my service. I agree to indemnify, defend and save harmless North Harris County College, its officers and employees from any and all claims and losses accruing or resulting in connection with my performance of this agreement.

Date 4/15/88 Contractor Signature

2. CERTIFICATION AND JUSTIFICATION REGARDING THE NEED FOR THESE SERVICES:

I hereby authorize the obligation of funds (indicated in item 1.g. above) and certify to the following conditions:

1) These services are essential and cannot be provided by persons receiving salary or otherwise compensated for their services.
2) A selection process has been employed to secure the qualified person available.
3) The charge is appropriate considering the qualifications of the consultant, his normal charges, and the nature of the services rendered.

APPROVALS:

ORIGINATOR

PRESIDENT

Date 4/13/88

Distribution: White: Attach to check request with invoice
Pink: Contractor
Yellow: Department

6.

APPENDIX 4

ATTACHMENT A

STATEMENT OF SERVICES TO BE PERFORMED

The Center for Occupational Research and Development (CORD) will assist North Harris County College (NHCC) in developing a Telecommunications Curriculum for two-year postsecondary schools in Texas. The curriculum will be structured so that a sequence of identified telecommunications specialty courses can be used with an advanced-technology common core curriculum. The design will be a competency-based curriculum based on the identified needs of employers of telecommunications technicians. CORD will accomplish the tasks listed below:

1. Validate the competencies required to be taught to telecommunications technicians. This will be accomplished by conducting a survey of telecommunications experts identified by members of the advisory committee that met on March 23, 1988. About one hundred surveys will be mailed.

2. Construct a matrix that shows a match between competencies and the telecommunication courses. The matrix lists competencies along the left side of the page and course titles across the top. Then by a process of analysis and comparison all competencies that are satisfied by a course are indicated in the matrix table.

3. Recommend a telecommunications curriculum that includes a sequence of five to seven specialty courses that build upon the courses that support advanced-technology technician training. CORD will also provide course descriptions for all courses.

To successfully complete the contract, CORD must furnish NHCC with the following products:

1. Report on survey of telecommunications experts.
2. Matrix of competencies and courses.
3. Telecommunications curriculum with course descriptions.

PAYMENT FOR SERVICES RENDERED

CORD will be reimbursed for actual expenses incurred, not to exceed $10,000. CORD agrees to provide, upon request, documentation for all expenses billed to NHCC. Invoices may be submitted monthly. The final invoice must be received by NHCC no later than 15 days after the completion of the contracted services.

COMPLETION DATE

All work associated with this contract must be completed no later than May 31, 1988.

APPENDIX 5

TELECOMMUNICATIONS TECHNOLOGY
TSTI-SWEETWATER AND NORTH HARRIS COUNTY COLLEGE
ADVISORY COMMITTEE MEETING

March 24, 1988

PRESENT:

Sudqi Alayyan - Texas Tech University, Lubbock, TX.
James T. Allen - Westex Towers, Inc., Sweetwater, TX.
Jim Alleman - North Harris County College, Kingwood, TX.
Kent Brooks - TSTI-Sweetwater
Roger Dennis - DCC, Abilene, TX.
Keith Johnson - KTAB-TV, Abilene, TX.
Henry Klingler - TSTI, Abilene, TX.
Ray Labelle - CENTEL, Houston, TX.
Jim Lovett - CORD, Waco, TX.
Jim Maxey - CENTEL, Houston, TX.
Dick McAdams - COMSUL, Houston, TX.
John Nicholas - American General Insurance, Houston, TX.
Gail Phillips - North Harris County College, Kingwood, TX.
Jerry P. Ratzlaff - Southwestern Bell Telephone Co., Dallas, TX.
Albert M. Scarborough - United Cable TV, Abilene, TX.
Mark Shafer - Motorola, Spring, TX.
Jim Sinopoli - OTM Engineering, Austin, TX.
James Bob Tabor - FAA, Houston, TX.
Maureen Weyel - S.W. Bell Telephone, Houston, TX.
John White - TSTI, Abilene, TX.

One committee member could not attend: Steve Nichols, ICC Intertel, Houston, TX.

Lunch was served at 11:30 a.m. with the meeting following.

The official business meeting was called to order by Gail Phillips, Division IV Head, East Campus, NHCC. He bestowed a warm welcome to all present and introductions were made.

Dr. Nellie Thorogood, President of NHCC, East Campus, also welcomed all participants and encouraged a lively discussion so that much could be accomplished in revising curriculum for the telecommunications training necessary for today's industry.

Dr. Kent Brooks, TSTI-Sweetwater, spoke on the objectives of the meeting--to seek advice on revising and standardizing the curriculum of the technology program so as to provide the best training possible to meet the needs of the telecommunication industry, locally and statewide.

Project Objectives

1. To validate current curriculum courses and skills.
2. To develop generic curriculum which can be used by NHCC and TSTI and other community/junior colleges and technical institutes in Texas.

Advisory Committee Functions

1. To review current curriculum elements.
2. To assist in conducting needs analysis.
3. To assist in a Task Survey.

Dr. Brooks discussed the need to develop a database of names of people in the telecommunications business in order to send them a task/skills questionnaire for feedback as to industry's needs for technician training. The skills would be ranked and categorized to determine priority of needs to be addressed with regard to curriculum.

Dr. Brooks also gave a history of TSTI, locations of campuses, and the TSTI approach toward accomplishing an AAS degree.

John White, TSTI, presented the current curriculum for their school and a brief description of the courses offered. Each participant was given a notebook filled with numerous handouts regarding curriculum. TSTI-Sweetwater is on a quarter system. A student can complete the electronics courses in six quarters and take basic courses necessary for the AAS degree elsewhere.

Gail Phillips spoke regarding the history of North Harris County College, locations of campuses, current curriculum, the requirements of the Southern Association, and the NHCC policy of an 18 hour CORE curriculum of math/sciences, English communication, and Social and Behavioral Sciences in addition to the technical courses necessary to award an AAS degree. NHCC is on the semester system (16 weeks each). A student can complete the entire electronics course and the basic CORE courses in a two-year program. Mr. Phillips explained the co-requirement and "stopping point" courses which students must master before continuing through additional courses.

Mr. Phillips stressed that technical specialty courses must be carefully selected. While NHCC wants to be up-to-date with the community needs, they cannot add everything that is new and desirable because of the ever changing needs and specialties of the individual industries.

Two NHCC instructors were introduced. Bob Tabor, currently employed with the F.A.A., is an adjunct faculty member at NHCC. He teaches Basic Analog and Digital Communications and Telecommunication Systems I. John Nicholas is employed by American General Insurance Company in data communications and is an adjunct faculty teaching Data Communications. Each gentleman briefly described the course content as it is taught at NHCC. Gail Phillips discussed the Electronics Program with both the Telecommunications Specialization taught at NHCC, East Campus, versus the Computer Hardware Specialization which is taught at NHCC, South Campus, to show that there are courses available covering each aspect of electronics training.

Jim Lovett, representative from CORD, was introduced. CORD is a private, non-profit company from Waco, Texas. They work with developing curricula in high schools and colleges. They have a special interest in technician training programs with experience in assembling and advising committees and formulating task lists. Through the use of visual aids, Mr. Lovett showed common needs of technicians and courses to solve these needs.

Common Needs of Technicians

1. System orientation - broad based
2. Combination of skills--interdisciplinary (electrical, mechanical, fluid, thermal, optical, microcomputers)
3. Strong technical bases
4. Interpersonal communication skills

Common Courses Needed

1. Support Courses:
    - Math
    - Communication
    - Shop Skills
    - Graphics

2. Principal Courses
    - Physics
    - Chemistry - material properties
    - Electrical Fundamentals

3. Technical Courses

- Electronic
- Electrical
- Electromechanical--relays, clock, timing devices
- Mechanical
- Fluids
- Heating and Cooling

Mr. Lovett showed a curriculum model for a two-year technology program with a list of competencies for a telecommunication technician.

Dr. Brooks then asked for a response from the participants and received the following:

Jim Sinopoli - need for network management and toubleshooting skills; need for hardware skills but also software skills.

Mark Shafer - technicians should be able to determine whether a situation is a hardware or software problem; also, salesmanship skills are needed.

Bob Tabor - need for relationship between hardware and software and should be able to switch from one application mode to another.

John Nicholas - should have more exposure to and a general appreciation for data comunications; knowledge that telephones and modems are different; basic telephony.

Maureen Weyel - technicians need basic transmission concepts, analog to digital conversions; need broad and basic knowledge of how data communication work and let the companies fine tune the training.

Dick McAdams - technicians need a basic computer literacy course and know how to use computer from the user's standpoint; What impact will ISDN have on the industry? Also, a need for verbal communication, basic presentation, and the selling of technician's self and company.

Jim Maxie - feels the greatest need is to learn the very basics in the courses;

Ray Labelle - need for basic electricity (power & grounding); general knowledge and understanding of operating system; understanding cabling; good verbal communication; basic troubleshooting (is it modem, switch, software?).

Keith Johnson - sees need for professional attitude; more software skills (MS-DOS, PASCAL, BASIC); circuit board projects (both NHCC and TSTI have some project-type work); training for technical management.

Jerry Ratzlaff - possibility of management skills through courses such as Industrial Psychology but technical skills are more important in school programs--companies can develop management skills in potential candidates; knowledge of keyboards, basic knowledge of digital communication; basic block diagram into switching systems; telephony, possibly as a separate course.

James Allen - cautioned educators not to condense the courses any further--there is too much to learn now.

Albert Scarborough - need for basic AC/DC circuitry; digital and microprocessing digitry.

Henry Klinger - feels there had been many good ideas presented but no school can turn out a graduate who could do everything and solve all of industry's needs.

Sudqi Alayyan - need for AC/DC and microprocessor training; knowledge of all operation systems and understand concepts and debugging of them; favors a good basic knowledge; would like to see co-op programs to give trained people experience that marketplace demands.

Roger Dennis - feels schools should spend time on basic training in electronics and possibly have consultants who can help teach personal grooming and appearance, mannerisms, confidence, etc.

A question was asked, "Should curriculum be generic or should major emphasis be placed on industry needs?"

John Nicholas - feels generic training in school is best with knowledge that technician can specialize in later years.

Jim Sinopoli - favored generic curriculum because it produces a technician who is "a diamond in the rough."

Dick McAdams - made a comment regarding the importance in our mobile society to be able to be trained in one area of the state and be qualified to go into another area and feel competent.

Keith Johnson - felt both curriculum approaches are similar and adequate but again stressed the need for personal computer literacy.

Dr. Brooks reminded the participants that there were three things to be done by each participant: (1) complete the List of competencies (supplied); (2) complete the Needs Assessment Sheet (supplied); and (3) prepare a list of ten people in the Telecommunication industry for the purpose of collecting additional data on technicial training needs so as to provide a better curriculum.

Participants may address mail to Dr. Brooks at:

Dr. Kent Brooks
TSTI-Sweetwater
Route 3, Box 18
Sweetwater, Texas 79556

Dr. Brooks thanked NHCC for hosting this meeting and everyone for coming and participating.

Gail Phillips made a few closing remarks and also thanked all particpants for their input on this day and for future imput as the need arises.

Following the close of the meeting, there was a tour of NHCC and the Electronics laboratories and classrooms.

Barbara Sirianni
Division IV Secretary
North Harris County College

Kent Brooks, Project Coordinator
TSTI-Sweetwater

APPENDIX 6

TELECOMMUNICATIONS TECHNOLOGY
TSTI-SWEETWATER AND NORTH HARRIS COUNTY COLLEGE
2ND ADVISORY COMMITTEE MEETING

June 7, 1988

PRESENT:

Sudqi Alayyan - Texas Tech University, Lubbock, TX.
James T. Allen - Westex Towers, Inc., Sweetwater, TX.
Jim Alleman - North Harris County College, Kingwood, TX.
Kent Brooks - TSTI-Sweetwater, TX.
Pierre Catala - Texas A&M, College Station, TX.
Roger Dennis - Dennis Communications, Abilene, TX.
Keith Johnson - KTAB-TV, Abilene, TX.
Henry Klingler - TSTI, Abilene, TX.
Jim Lovett - CORD, Waco, TX.
Dick McAdams - COMSUL, Houston, TX.
John Nicholas - American General, Houston, TX.
Gail Phillips - NHCC, Kingwood, TX.
Albert Scarborough - United Cable, Abilene, TX.
Mark Shafer - Motorola, Spring, TX.
Kenne Turner - NHCC, Kingwood, TX.
Maureen Weyel - S.W. Bell Telephone, Houston, TX.
John White - TSTI, Abilene, TX.

Those committee members unable to attend include:

Ray Labelle - CENTEL, Houston, TX.
Jim Maxey - CENTEL, Houston, TX.
Jerry P. Ratzlaff - S.W. Bell Telephone, Dallas, TX.
Jim Sinopoli - OTM Engineering, Austin, TX.
James Bob Tabor - FAA, Houston, TX.

Lunch was served at noon at North Harris County College, East Campus, Kingwood, Texas, with the meeting following.

Gail Phillips, Division IV Head, East Campus, NHCC, called the meeting to order and welcomed all who were present. NHCC Campus President, Dr. Nellie Thorogood, also welcomed all participants and thanked them for giving their time and input into this project.

Dr. Kent Brooks, TSTI-Sweetwater, gave an overview of the events leading up to this second meeting.

- Dr. Clay Johnson, TSTI, and Dr. Nellie Thorogood, NHCC, discussed the need for this telecommunication project.

- Mission to be accomplished was twofold:

  (1) the verification of the skills necessary for technicians in the industry to be determined by use of advisary committees made up of industry personnel.

  (2) the development of curriculum for a two year training program to meet these needs.

- Funding was made available in the fall of 1987 with the project being started in January, 1988. The idea was to build on work that had already been done through college training programs and with the help of the Center for Occupational Research and Development (CORD) and Jim Lovett.

- project staff met and developed a competency list to determine skills needed. CORD completed a generic curriculum which was reviewed by TSTI.

- First joint advisory committee meeting was held at NHCC on March 24, 1988. Both NHCC and TSTI shared their present curricula. Advisory committees were asked to make suggestions and comments.

- TSTI contracted with NHCC for assistance in project development. NHCC subcontracted with CORD for assistance in developing and implementing a competency survey.

- Survey directed to industry needs (competencies) was distributed and completed by each participant.

Meeting today is to review CORD's task survey and generic course matrix based on the Abilene meeting of May 17, 1988, attended by representatives of TSTI, NHCC, and Jim Lovett of CORD. The end result will be a curriculum guide with an essential equipment list. Dr. Brooks asked for suggestions regarding reference books, texts, resource materials, or video productions used in industry from those present. He also handed out a booklet, "Generic Curriculum for Telecommunications" which is the preliminary draft of all the information concerning this project. Each participant was asked to review these booklets.

The meeting was turned over to Jim Lovett of CORD. Mr. Lovett handed out a three part telecommunication survey. This included the actual survey of competencies which was sent out to 127 people in the telecommunication industry, the names and addresses of those to whom the survey was sent, and the results of the survey. The competencies listed were the result of those which CORD had used previously and some which were supplied by TSTI. A question arose regarding the teaching of fiber optics. Mr. Lovett indicated that there is not much to teach right now and what is available can be taught in one course. The names and addresses were those supplied by the joint advisory committees and some were mailed to training officers in some communication organizations.

Mr. Lovett continued by handing out a Model Competency Matrix for a Telecommunication Technician. This breakdown included two charts and a matrix based on courses being taught and how they correspond to competencies desired. Courses were broken down into three areas--basic core, technical core, and specialty areas. Participants were given 10-15 minutes to review charts and the floor was open for discussion on these charts and matrix.

The Telecommunications Chart brought about much discussion from the group. The original chart had a breakdown into two major groupings with "analog" and "digital" on the left side and "radio frequency", "microwave" and "light" on the right side. These groupings were further broken down with "voice" and "video" under the "analog" grouping; "voice", "digital" and "data" under "digital"; "antenna" under "radio frequency" and "microwave"; and "transmission" under "microwave" and "light". A vote was taken to include an additional category called "cable" on the right side of the chart along with the "radio frequency", "microwave" and "light" groups and a subgrouping under "cable" to read "switches and methods". A second suggestion was made to add "data" under the "analog" grouping on the left side of the chart. Comments were made that analog and digital were merging. It was also suggested that the term "video imagery" should be a subgroup under "digital" rather than just "video".

Regarding the matrix, much discussion followed regarding several of the competencies and Mr. Lovett suggested each participant should review the matrix and make corrections or suggestions and return these to CORD before the end of the meeting so that he could digest the suggestions and revise the matrix.

An NHCC Matrix and a TSTI Matrix were also handed out to show which courses are currently being offered to cover the competencies. These were provided for information only and each school was given the task of correcting these where necessary and returning them to CORD also.

A question was asked as to how the current curriculum was set up. Gail Phillips briefly discussed the "usual" way curriculum is determined. In most instances, an institution sees a need for a particular program, hires a qualified instructor who selects a text, orders necessary equipment and the program eventually evolves into a curriculum which attempts to meet the needs of industry. CORD's approach of starting with a task analysis and a list of competencies desired by industry and then developing a curriculum around these competencies is a better way to train technicians to fill industry's needs and make these people marketable in their communities. Industry must realize, however, that there are limitations in a two year plan and institutions must carefully decide what is to be taught and what must be eliminated. The two-year institutions train technicians only on the entry level and then the student must decide whether to go on to a four year institution or industry must train for its specialties.

Dr. Brooks stated that within the next year or so, the Coordinating Board, which governs all two and four year institutions, will be putting forth new guidelines. In the future, course descriptions are going to have to be competency based. All new programs will involve a great deal of research prior to developing new programs. By taking the action that has been taken here, the telecommunications program at NHCC and TSTI will be ahead of many other programs in this area.

While the primary purpose of a two year institution is to train people for jobs, there is an ongoing attempt to articulate the program with four year courses. Discussion followed with representatives from A&M and Texas Tech.

Evaluation forms were handed out to each participant to evaluate the project.

Dr. Brooks expressed appreciation for all who participated in this project. He stated a final complete report will be sent to each person. He thanked NHCC for their hospitality and Jim Lovett for all his efforts. Gail Phillips also thanked all participants and after a few closing remarks, the meeting was concluded.

Barbara Sirianni
Division IV Secretary
North Harris County College

Kent Brooks
Project Coordinator
TSTI-Sweetwater

APPENDIX 7
SUMMARY
NEEDS ASSESSMENT

DATE: ________________

FOR

TELECOMMUNICATIONS TECHNOLOGY

Telecommunications technicians have a strong electronic background -- including active devices/circuits, digital and analog devices - who understand communications technology from radio frequency to microwave and optical technology. They can install, test, troubleshoot, repair and maintain modern telecommunications equipment and components. *

In response to changes and trends in the telecommunications industry, TSTI-Sweetwater is conducting an assessment of the needs for technical training in this industry. Please respond to each of the questions below.

The industry your company represents is ______________

____

The name of your company is ______________________

____

1. Is there a growing need or trend for highly trained telecommunications technicians in your company or industry? (Check one.)

   yes 8 no 0

2. Does your company or industry employ telecommunications technicians?

   yes 8 no 0

   If so, are they adequately trained for jobs?

   yes 4 no 2 maybe 3

3. Is there a shortage of qualified telecommunications technicians in your company or industry?

   yes 3 no 2 maybe 2

   If there is a shortage, estimate the number of employees needed.

   2 answers
   (3 to 5) (2) — 2 years from now
   (5 to 10) (3) — 5 years from now

---

* Definition adpated from the Center for Occupational Research and Development, Waco, Texas.

75

4. Would your company be willing to hire graduates with an Associate of Applied Science degree in telecommunications technology?

yes 7 no 0 maybe 0

5. Would your company or industry give special consideration to employing a person with an associate degree in a telecommunications technology, as opposed to an applicant who does not have a degree?

yes 7 no 0 maybe 0

6. Would your company or industry likely pay more at job entry for a person with an associate degree in telecommunications technology, as opposed to a person who does not have a degree?

yes 6 no 1 maybe 0

7. What starting salary range would your company or industry likely pay for an entry-level telecommunications technician?

______ $12,000-$15,000
3 $15,000-$18,000
2 $18,000-$21,000
1 $21,000-$25,000
2 $25,000+

8. Would a person with a telecommunications technology degree employed by your company or industry likely:

a) have greater job assignment flexibility

yes 7 no ______ maybe 1

b) have greater promotion opportunities

yes 6 no ______ maybe 2

c) have all salary advancement opportunities

yes 8 no 0 maybe 0

d) be less subject to cutbacks and layoffs

yes 4 no 1 maybe 3

9. Please check the areas you feel a telecommunications technician should receive training.

7 Transmitters and Receivers
5 Solid State Devices
3 Cable Television
3 Video Generation and Processing
7 Analog and Digital Systems with Interconnect
5 Advanced Mobile and Fixed Radio
2 Image Processing
5 Computer Applications
1 Hydraulics
1 Pneumatics
6 Fiber Optics
Other (Please Specify) Pgm. Input Devises (1), Operating Systems-interfac requirements (1), Data Communications (1), PC Communications (2), MS-DOS (1 (1) Schematic Reading

6 Telephone Systems
7 Antenna Systems
7 Digital
2 Broadcast
5 Opto/Laser Technology
5 Microwave and Satellite
5 Operational Amplifiers
6 Electronic Circuits
5 Microprocessors
1 Manufacturing Processes
1 Management
4 Drafting
7 Safety

10. Would you or your company be willing to assist TSTI with developing the telecommunications technology program?

yes 8 no 0 maybe 0

If willing to assist, please provide name, address and telephone number.
Six left names and addresses and telephone numbers.

11. Comments.

3 made comments -- all favorable. (See attached)

11. Comments.

A. Curriculum presented by TSTI and NHCCC is good. Would be helpful if math could run concurrently with subjects.

B. I am very impressed with the progress and make-up of your curriculum to date.

C. Enjoyed the meeting. It made me realize that not only do the educational institutions have a responsibility to train the technicians, but the employers also have to continue that training after they're hired.

APPENDIX 8
TSTI-SWEETWATER
TELECOMMUNICATIONS TECHNOLOGY
REVISED CURRICULUM 1988

FIRST QUARTER

COURSE NUMBER	COURSE NAME	LEC HRS	LAB HRS	CLOCK HOURS	CREDITS
ART 111	INDUSTRIAL SAFETY	1	1	24	1
CST 123	COMPUTER OPERATING SYSTEMS I	2	4	72	3
ELT 111	BASIC ELECTRONIC CIRCUITS	3	8	132	5
ENGL 104	COMPOSITION I	4	0	48	4
GT 110	ORIENTATION	1	0	12	1
MATH 104	COLLEGE ALGEBRA I	4	0	48	4
QUARTERLY TOTALS		15	13	336	18

SECOND QUARTER

COURSE NUMBER	COURSE NAME	LEC HRS	LAB HRS	CLOCK HOURS	CREDITS
ELT 121	SOLID STATE DEVICES	2	3	60	3
ELT 122	SOLID STATE CIRCUITS	4	6	120	6
ELT 123	ADVANCED ELECTRONIC CIRCUITS	3	8	132	5
MATH 124	PLANE TRIGONOMETRY	4	0	48	4
QUARTERLY TOTALS		13	17	360	18

EXIT POINT: ELECTRONICS APPRENTICE TECHNICIAN I
696 CONTACT HOURS 36 CREDITS

THIRD QUARTER

COURSE NUMBER	COURSE NAME	LEC HRS	LAB HRS	CLOCK HOURS	CREDITS
CMT 132	DIGITAL I	2	3	60	3
CMT 133	DIGITAL II	3	7	120	5
ELT 131	OPTO/LASER TECHNOLOGY	2	3	60	3
ELT 132	OPERATIONAL AMPLIFIERS	2	4	72	3
ENGL 134	SPEECH COMMUNICATIONS	4	0	48	4
QUARTERLY TOTALS		13	17	360	18

FOURTH QUARTER

COURSE NUMBER	COURSE NAME	LEC HRS	LAB HRS	CLOCK HOURS	CREDITS
CMT 141	MICROPROCESSOR I	1	4	60	2
CMT 142	MICROPROCESSOR II	2	6	96	4
CMT 143	IMAGE SYSTEMS	2	3	60	3
PHYS 134	COLLEGE PHYSICS	3	3	72	4
PSYC 104	GENERAL PSYCHOLOGY	4	0	48	4
TDN 140	ELECTRO-MECHANICAL DRAFTING	1	4	60	2
QUARTERLY TOTALS		13	20	396	19

EXIT POINT: ELECTRONICS APPRENTICE TECHNICIAN II
1452 CONTACT HOURS - 73 CREDITS

FIFTH QUARTER

COURSE NUMBER	COURSE NAME	LEC HRS	LAB HRS	CLOCK HOURS	CREDITS
ELT 214	PRINTED CIRCUIT BOARDS	1	3	48	2
TCC 211	BASIC TRANSMITTERS AND RECEIVERS	3	6	108	5
TCC 212	ANTENNA SYSTEMS	2	3	60	3
TCC 213	ADVANCED IMAGE PROCESSING	1	3	48	2
TCC 214	ANALOG & DIGITAL SYSTEMS WITH INTERCONNECT	2	3	60	3
QUARTERLY TOTALS		9	18	324	15

SIXTH QUARTER

COURSE NUMBER	COURSE NAME	LEC HRS	LAB HRS	CLOCK HOURS	CREDITS
TCC 221	MOBILE AND FIXED RADIO	2	3	60	3
TCC 222	TELEPHONE SYSTEMS	2	3	60	3
TCC 223	CABLE TELEVISION	2	3	60	3
TCC 224	BROADCAST	2	3	60	3
TCC 225	MICROWAVE AND SATELLITE	2	3	60	3
TCC 226	CERTIFICATION	1	3	48	2
QUARTERLY TOTALS		11	18	348	17
PROGRAM GRAND TOTALS		74	103	2124	105

NOMINAL TIME REQUIRED: SIX QUARTERS

ASSOCIATE OF APPLIED SCIENCE DEGREE IN TELECOMMUNICATIONS TECHNOLOGY
2124 HOURS - 105 CREDITS

TSTI-SWEETWATER

TELECOMMUNICATIONS TECHNOLOGY

COURSE DESCRIPTIONS

Effective Date: Fall 1988

TCC 211 BASIC TRANSMITTERS AND RECEIVERS 3-6-108-5

This class covers the introduction to basic theory, applications, tuning procedures, power and modulation checks on AM, sideband, TV and FM transmitters and receivers.

TCC 212 ANTENNA SYSTEMS 2-3-60-3

Theory and application of current antenna design are taught. Emphasis will be on matching and loading with special emphasis on phasing for pattern and direction effects, reflected waves and multipath. Also covered will be the types and uses of transmission lines.

TCC 213 ADVANCED IMAGE PROCESSING 1-3-48-2

Indepth technical analysis of analog and digital video devices. Special emphasis directed toward testing, troubleshooting and repair of equipment.

TCC 214 ANALOG AND DIGITAL SYSTEMS WITH INTERCONNECT 2-3-60-3

This course covers analog and digital systems, networks, multiplexing, switching and interfaces. This theory and application is then applied to interconnects between various users: Two Way Radio, Mobile Telephone, Microwave, Satellite and Fiber Optic Carriers.

TCC 221 MOBILE AND FIXED RADIO 2-3-60-3

This class covers advanced FM transmitters, receivers, repeaters, trucking cellular systems as well as mobile phone systems, pagers, computer logging, line interconnect and microwave interconnecting.

TCC 222 TELEPHONE SYSTEMS 2-3-60-3

Central office switches, electronic digital switches, interoffice connect, concentrators, multiplexing, stand-by power, tandem offices, and end office are designated primary in this class. Secondary will be general plant layout, loading coils, regenerative repeaters, PBX and interconnecting customer equipment, with special attention to the common language sheet.

TSTI-SWEETWATER

TELECOMMUNICATIONS TECHNOLOGY

COURSE DESCRIPTIONS

TCC 223 CABLE TELEVISION 2-3-60-3

In this class, the student will study cable TV headend, signal processors, modulators, FM signal processing (mixing, levels, testing and monitoring). Additional subjects covered are system noise, system layout (overhead and underground types), cable losses, amplifier spacing, amplifier levels, extenders, line taps, house drops, system balancing and FCC tests.

TCC 224 BROADCAST 2-3-60-3

The students will learn the theory and operation of AM control, antennas, AM transmitters, AM interconnects, remote control, directional arrays, and AM stereo. The students will also learn the theory and operation of FM control, FM transmitters, and electronic news gathering systems. Television studio production, studio control, master control, satellite interconnect, network feeds, syndicated programming, VHF transmitters and antennas, UHF transmitters and antennas, and studio transmitter microwave links are included.

TCC 225 MICROWAVE AND SATELLITE 2-3-60-3

This class teaches microwave and satellite principles, antenna types and application, wave-guide types and application, space loss, beam widths, antenna gain and antenna noise temperature. The student will study various microwave transmitters and receivers, learn to understand and measure levels, power, frequency and deviation at block levels and with practical application in the laboratory.

TCC 226 CERTIFICATION 1-3-48-2

This class will review the types of questions and problems which are encountered in the certification examination giver by FCC, NABER, ISCET, NARTE, SBE, and SCTE. Each student will be prepared and encouraged to participate in one of the above examinations.

TSTI-SWEETWATER

TELECOMMUNICATIONS TECHNOLOGY

SUPPORT COURSE DESCRIPTIONS

Effective Date Fall, 1988

ART 111 INDUSTRIAL SAFETY 1-1-24-1

This course is structured to create an awareness of the many safety hazards present within the industrial environment. History and growth of O.S.H.A., Human Behavior, personal Protection, Electrical, Machine and Robotic safety will be studied.

CMT 132 DIGITAL I 2-3-60-3

This is a study of basic digital logic and it's application. It includes a study of number systems common to computers.

CMT 133 DIGITAL II 3-7-120-5

This is a study of advanced digital logic and it's application. It includes flip-flops, shift registers, counters, and memories. Prerequisite: CMT 132.

CMT 141 MICROPROCESSOR I 1-4-60-2

Organization and architecture of microprocessors/microcomputer systems including basic programming for operation and check-out of computer system functions.

CMT 142 MICROPROCESSOR II 2-6-96-4

Digital computer, logical circuits, memory circuits, arithmetic circuits and computer operations are explored. Digital fault isolation is emphasized. Actual minicomputers will be utilized by students. Prerequisite: Program Chairperson Approval

CMT 143 IMAGE SYSTEMS 2-3-60-3

The three major aspects of image systems, image capture, image processing, and image display, are taught as closely interrelated disciplines, emphasizing digital techniques. The basic characteristics of images are described first, followed by studies of image capture utilizing video cameras, various scanners and transducers. Image display using video monitors, printers and sound transducers is presented, followed by a study of computer processing, manipulation and conversion of various image formats. Prerequisite: CMT 132, CMT 133.

TSTI-SWEETWATER

TELECOMMUNICATIONS TECHNOLOGY

SUPPORT COURSE DESCRIPTIONS

CST 123 COMPUTER OPERATING SYSTEMS I 2-4-72-3

This course is a study of operating systems used on microcomputers including both single user and multi user environments. Course work will include mastery of system commands, text editors, procedures, and utility operations. Prerequisite: NONE

ELT 111 BASIC ELECTRONIC CIRCUITS 3-8-132-5

The fundamentals of direct current which includes the study of voltage, current, resistance, conductance, power and Kirchoff's laws. Network analysis as applied to DC resistive circuits will be studied. Superposition, Millman, Thevenin and Norton theorems will be studied along with a loop and nodal analysis of complex circuits.

ELT 121 SOLID STATE DEVICES 2-3-60-3

This course presents a detailed study of the theory of operation of solid state devices commonly utilized in industry today. Prerequisite: Program Chairperson Approval.

ELT 122 SOLID STATE CIRCUITS 4-6-120-6

The student learns the operational characteristics of solid state components utilized in amplifiers, detectors, oscillators and other electronic circuits. Analysis of static and dynamic characteristics, bias techniques and environmental considerations will be provided. Prerequisite: Program Chairperson Approval

ELT 123 ADVANCED ELECTRONIC CIRCUITS 3-8-132-5

Fundamentals of alternating current to include inductive, capacitive and RCL networks. Pulse circuits, time constants, Vector analysis, filters, phase shifting circuits and true and apparent power will be emphasized. Polar-rectangular conversions, and impedance and admittance vectors.

ELT 131 OPTO/LASER TECHNOLOGY 2-3-60-3

This is a basic course to define basic optical terms and concepts; compare laser light with ordinary light; identify the laser essential components; identify various types of lasers; recognize safety hazards particular to different laser group; choose accessories for different laser applications; and to calculate power density of lasers. The overall intention of the course is to allow the student the opportunity to become more laser literate. Prerequisite: Program Chairperson Approval

TSTI-SWEETWATER

TELECOMMUNICATIONS TECHNOLOGY

SUPPORT COURSE DESCRIPTIONS

ELT 132 OPERATIONAL AMPLIFIERS 2-4-72-3

This course presents the design and operation of basic operational amplifier circuits. It includes various amplifier circuits, linear and nonlinear applications, differentiators, integrators and generators. Prerequisite: Program Chairperson Approval.

ELT 214 PRINTED CIRCUIT BOARDS 1-3-48-2

This course considers the design and manufacture of printed circuit board technology. Upon completion, the student will be able to build printed circuit boards using both direct pattern and photographic methods. Included in the course will be hands-on learning exercises in the design, layout and production of Printed Circuit Boards. Prerequisite: Program Chairperson Approval.

GT 110 ORIENTATION 1-0-12-1

This course acquaints the student with the organization, structure, history, principles and course offerings at Texas State Technical Institute. Prerequisite: NONE

TDN 140 ELECTRO-MECHANICAL DRAFTING 1-4-60-2

A course consisting of basic exercise in lettering, use of instruments, geometric construction and orthographic projection. Electronic symbols and their application in printed circuits with an introduction to CAD applications for Printed Circuit Boards design will be emphasized.

TSTI-SWEETWATER

TELECOMMUNICATIONS TECHNOLOGY

GENERAL EDUCATION COURSE DESCRIPTIONS

Effective Date: Fall 1988

ENGL 104 COMPOSITION I 4-0-48-4

Principles and techniques of written composition, textual analysis, and critical thinking. Prerequisite: Successful completion of the diagnostic test.

ENGL 134 SPEECH COMMUNICATION 4-0-48-4

Theories and practice of speech communication behavior in interpersonal, small group and public communication situations. Prerequisite: Successful completion of the diagnostic.

MATH 104 COLLEGE ALGEBRA I 4-0-48-4

A study of relations and functions, inequalities, factoring, polynomials, rational expressions and quadratics with an introduction to complex numbers, and logarithmic functions, determinants and matrices, sequences and series. Prerequisite: Successful completion of diagnostic test.

MATH 124 PLANE TRIGONOMETRY 4-0-48-4

Trigonometric functions, identities, equations and applications. Prerequisite: MATH 104.

PHYS 134 COLLEGE PHYSICS 3-3-72-4

An algebra level physics sequence, including laboratories, which studies mechanics, heat, waves, electricity and magnetism, and modern physics. Prerequisite: MATH 104.

PSYC 104 GENERAL PSYCHOLOGY 4-0-48-4

A survey of the major topics in psychology. Introduces the study of behavior and the factors that determine and affect behavior.

APPENDIX 9
NORTH HARRIS COUNTY COLLEGE
TELECOMMUNICATIONS TECHNOLOGY
Associate of Applied Science
Proposed Curriculum

NUMBER		TITLE	LEC	LAB	CONTACT HR	CREDIT HR
		First Semester				
ELT	140	ELECTRO-MECHANICAL HANDSKILLS	3	3	96	4
ELT	141	CIRCUIT ANALYSIS I	3	3	96	4
*MATH	138	TECHNICAL MATHEMATICS II	3	0	48	3
ENG	132	COMPOSITION AND RHETORIC I	3	0	48	3
PE	110-114	PHYSICAL EDUCATION	0	3	48	1
PSY	231	GENERAL PSYCHOLOGY				
OR						
SOC	131	PRINCIPLES OF SOCIOLOGY	3	0	48	3
						18
		Second Semester				
ELT	142	CIRCUIT ANALYSIS II	3	3	96	4
ELT	143	ELECTRONICS I	3	3	96	4
ELT	243	DIGITAL ELECTRONICS	3	3	96	4
*MATH	139	TECHNICAL TRIGONOMETRY	3	0	48	3
ENG	236	TECHNICAL COMMUNICATIONS	3	0	48	3
						18
		Third Semester				
ELT	240	ELECTRONICS II	3	3	96	4
ELT	245	MICROPROCESSORS I	3	3	96	4
ELT	242	BASIC ANALOG AND DIGITAL COMMUNICATIONS	3	3	96	4
ELT	244	DATA COMMUNICATIONS	3	3	96	4
						16
		Fourth Semester				
PHY	241	TECHNICAL PHYSICS	3	3	96	4
POL	231	AMERICAN GOVERNMENT: NATIONAL, STATE AND LOCAL I	3	0	48	3
ELT	247	TELECOMMUNICATIONS SYSTEMS	3	3	96	4
ELT	249	TELECOMMUNICATIONS INDUSTRIAL APPLICATIONS	3	3	96	4
OR						
ELT	230	TELECOMMUNICATIONS COOPERATIVE WORK EXPERIENCE AND SEMINAR	2	15	272	3
						14/15

*A STUDENT TRANSFERRING TO A SENIOR INSTITUTION SHOULD CONSIDER A HIGHER LEVEL OF MATH. FOR GUIDANCE, SEE ELECTRONICS DEPARTMENT OR COUNSELING OFFICE. STUDENTS SHOULD COMPLETE MATH PLACEMENT TESTING PRIOR TO BEGINNING THIS PROGRAM. ADDITIONAL DEVELOPMENTAL MATH COURSES MAY BE REQUIRED IF THE PREREQUISITE SKILLS HAVE NOT BEEN OBTAINED.

ELECTRONICS TECHNOLOGY

ELT 140 ELECTRO-MECHANICAL HANDSKILLS

Prerequisite: None
CREDIT: 4
3 hrs. Lec.
3 hrs. Lab

A course designed to expose the student to knowledge and handskills associated with electrical, electronic, and mechanical technologies by learning to fabricate a piece of electronic hardware, and an associated metalwork project. The laboratory work will emphasize the development of proficiency in the use of common handtools, soldering, chassis construction utilizing sheet metal, measurement systems and devices, and printed circuit board layout and construction.

ELT 141 CIRCUIT ANALYSIS I

Corequisite: Math 138
CREDIT: 4
3 hrs. Lec.
3 hrs. Lab

A study of the fundamentals of direct current to include an analysis of voltage, current, resistance and Ohm's Law with application to simple resistive circuits. In addition, a study into the theory and application of circuit analysis theorems with emphasis on complex resistive circuits.

ELT 142 CIRCUIT ANALYSIS II

Prerequisite: Elt 141
Corequisite: Math 139
CREDIT: 4
3 hrs. Lec.
3 hrs. Lab

A study of the fundamentals of alternating current, including production, propagation, and use in electronic circuits. The properties of capacitance, inductance, and magnetism will be discussed with application of circuit analysis using complex impedances in various R-L-C circuit combinations.

ELT 143 ELECTRONICS I

Prerequisite: Elt 141
Corequisite: Elt 142
CREDIT: 4
3 hrs. Lec.
3 hrs. Lab

A study of the fundamentals of basic semiconductor and active device properties. The construction and operation of the PN junction will be introduced along with the static and dynamic characteristics of practical diode circuits to include rectifiers, power supplies, regulators, etc. The bipolar transistor construction, characteristics and operation will also be introduced.

ELT 240 ELECTRONICS II

Prerequisite: Elt 143
CREDIT: 4
3 hrs. Lec.
3 hrs. Lab

An analysis of the basic design parameters, static and dynamic characteristics and frequency response of small and large signal amplifiers as well as DC amplifiers. Application of pulse, timing, and switching circuits, utilizing discrete components will be investigated. Fundamentals of specialized semiconductor devices will be discussed.

ELT 242 BASIC ANALOG AND DIGITAL COMMUNICATIONS

Prerequisite: ELT 143
CREDIT: 4
3 hrs. Lec.
3 hrs. Lab

An introductory course designed to provide the student with basic electronic communication techniques, theory and practices. Included will be transmission and receiving methods, modulation techniques, phase locked loops, transmission lines, antennas and electromagnetic wave propagation.

ELT 243 DIGITAL ELECTRONICS
Corequisite: Elt 142
CREDIT: 4
3 hrs. Lec.
3 hrs. Lab

A beginning course in digital and logic principles to include the binary, octal and hexidecimal number systems, coding, data representation, digital integrated circuits. Boolean Algebra and sequential logic: i.e., flip-flops, counters, registers, clocks, decoders, multiplexers and data bussing. An introduction to computer architecture, memory systems, input/output devices and microprocessors will be included. (Previously Elt 247).

ELT 244 DATA COMMUNICATIONS
Corequisite: ELT 242
CREDIT: 4
3 hrs. Lec.
3 hrs. Lab

An introduction to the fundamentals of data communications, local area networking, and the use of modems, modulation, encoding, and decoding theory in the transmission and reception of data. Error detection, protocols, multiplexing and packet switched networks will be included.

ELT 245 MICROPROCESSORS I
Prerequisite: ELT 243
CREDIT: 4
3 hrs. Lec.
3 hrs. Lab

A preliminary course in microprocessor hardware utilizing the 6800 microprocessor. This course will be divided into the following topical areas: number systems and codes, microprocessor basic ooperation, computer arithmetic, preliminary programming, basic interfacing and logic/signature analysis study. (Previously ELT 248).

ELT 247 - TELECOMMUNICATION SYSTEMS
Prerequisite: ELT 242
Credit: 4
3 hrs. Lec.
3 hrs. Lab

A course designed to expose the student to both analog and digital transmission of information using microwave and optics principles. The study includes: (a) microwave components, microwave propagation, antennas, microwave systems and their application in satellite communications; (b) optics and lightwave fundamentals as well as light sources, receivers, waveguides, connectors, modulations techniques and distribution systems. The integration of communications systems into local, regional and national networks will be presented.

ELT 249 - TELECOMMUNICATIONS INDUSTRIAL APPLICATIONS Credit: 4
Corequisite: ELT 242
3 hrs. Lec.
3 hrs. Lab

A summary study of the varied types of communications systems and their application to the business and industry setting as solutions to "real-world" telecommunications problems.

ELT 230 - TELECOMMUNICATIONS COOPERATIVE WORK EXPERIENCE AND SEMINAR Credit: 3
2 hrs. Lec.
15 hrs. Lab

Prerequisite: Enrollment in Electronics A.A.S. Degree Program; Completion of 15 hours in the Degree Plan; Departmental Approval

Cooperative education offers the student college credit for practical work experience related to career goals. Each student is assigned a coordinator to work with the student and employer to set individual co-op objectives related to job growth, personal development, problem solving, routine duties, and future career aspirations. The co-op coordinator will make on-site visits to assist the student in developing and coordinating co-op objectives. Enrichment seminars conducted thoughout the semester will assist the student's personal and career growth.

APPENDIX 10

Course Sequencing Chart
Telecommunication Technician
Suggested Program (Quarter System)

	Lecture	Lab	Weekly Contact Hours
First Quarter			
Algebra	3	2	5
UTC Physics I	3	6	9
Technical Communications	3	2	5
Computer Basics	2	4	6
* Introduction to Telecommunication Technology	3	0	3
	14	14	28
Second Quarter			
Trigonometry	3	2	5
UTC Physics II	3	6	9
Fundamentals of Electricity & Electronics	3	4	7
Graphics	1	6	7
	10	18	28
Third Quarter			
Analytic Geometry & Calculus	3	2	5
UTC Physics III	3	6	9
*Circuit Analysis	2	6	8
Mechanical Devices & Systems	2	4	6
	10	18	28
Fourth Quarter			
Active Devices & Systems	2	4	6
*Digital Electronics	2	6	8
Electromechanical Devices	3	4	7
Analog Circuits/Active Devices	2	6	8
	9	20	29
Fifth Quarter			
Industrial Electrical Power & Equipment	3	4	7
Computer Applications	3	4	7
Fluid Power	3	4	7
*Digital Devices/Systems	2	6	8
	11	18	29

*Specialty courses

Course Sequencing Chart
Telecommunication Technician
Suggested Program (Quarter System)

	Lecture	Lab	Weekly Contact Hours
Sixth Quarter			
Instrumentation & Controls	2	4	6
Economics in Technology	4	0	4
Manufacturing Processes	4	3	7
*RF/Microwave Communications	2	6	8
	12	13	25
Seventh Quarter			
Properties of Materials	2	4	6
Human Relations	5	0	5
Fiber-Optic Communications	2	6	8
	9	10	19

*Specialty courses

BASIC CORE COURSES

ALGEBRA

This course is designed to develop and update algebraic skills required for engineering technicians as applied to the solution of practical problems encountered in electrical, mechanical, thermal, hydraulic, pneumatic and optical technologies. Topics to be covered include functions and graphs, exponents, radicals, linear equations, determinants, factoring, quadratics, and various techniques for solutions of equations and systems of equations.

TRIGONOMETRY

This course is designed to develop trigonometric skills required for engineering technicians as applied to the solution of practical problems encountered in electrical, mechanical, thermal, hydraulic, pneumatic and optical technologies. Topics to be covered include trigonometric functions of angles, vectors, solutions to oblique triangles, graphs of trigonometric functions, j-operators, inverse functions and logarithms.

ANALYTIC GEOMETRY AND CALCULUS

This course is designed to develop analytic geometry and calculus skills required for engineering technicians as applied to the solution of practical problems encountered in electrical, mechanical, thermal, hydraulic, pneumatic, and optical technologies.

UTC PHYSICS I

A practical approach to the teaching of basic physics of force, work, rate, momentum, and resistance is presented in UTC Physics I. Students are shown, by classroom demonstration, how these five concepts are applied to the four energy systems—mechanical, fluid, electrical, and thermal. Students perform laboratory experiments that relate each concept to the four energy systems.

UTC PHYSICS II

The second quarter of UTC Physics builds on the foundation developed in the first quarter by presenting concepts of power, energy, force transformers, and energy convertors. Appropriate laboratories provide practical hands-on experience in working with associated devices in the four energy systems (mechanical, fluid, electrical and thermal).

UTC PHYSICS III

The third quarter of UTC Physics provides the student with practical knowledge of scientific principles involved in transducers, vibrations and waves, time constants, and radiation. Practical hands-on experience with devices common to many technologies is offered in the laboratory.

TECHNICAL COMMUNICATIONS

Technical Communications provides the student with a working knowledge of communication techniques, procedures, and formats used in industry and business. The student learns accepted methods of describing devices and processes; of making oral and written technical presentations; maintaining a laboratory notebook; and of using written manuals, guides, specifications and vendor instructions. Most importantly, the student is involved extensively in writing various technical reports and in preparing/delivering appropriate technical presentations.

COMPUTER BASICS

This course will provide students with knowledge and skills to use the microcomputer as a tool to solve engineering technology problems typically encountered throughout their programs. Topics taught will include microcomputer architecture, programming concepts, branching, looping, arrays, functions, subroutines, data files, graphics and applications.

ECONOMICS IN TECHNOLOGY

Economics in Technology develops the techniques necessary to evaluate the economic impact and advantages of different production methods. It is a course designed to familiarize the student with analysis techniques that are necessary for accurate cost evaluation of specific projects. The conceptual format enables the student to apply appropriate tools to a diversity of cost-related decisions.

INDUSTRIAL RELATIONS

This course includes the study of the basis of human relations and the organization of individual and group behavior. Leadership, organizational and social environments (including labor unions), career development, communications and group processes as well as selected operating activities are covered. Appropriate case problems are reviewed and discussed. Special emphasis is placed on typical industrial and business relationships in everyday situations.

TECHNICAL CORE COURSES

GRAPHICS

An introductory course that provides the technician with basic skills and techniques used to communicate information and ideas graphically. Topics include: an introduction to freehand sketching; basic drafting techniques and procedures; schematic drawing; descriptive geometry; and computer graphics.

PROPERTIES OF MATERIALS

A quantitative survey and description of the physical, chemical, mechanical, thermal, electrical, magnetic, acoustical and optical properties of materials. The course identifies and uses resource tables and handbooks extensively. Laboratory exercises provide the student with a broad exposure to the measurement of typical material properties.

MECHANICAL DEVICES AND SYSTEMS

Mechanical Devices and Systems is a study of the principles, concepts, and applications of various mechanisms encountered in industrial applications of engineering technology. Such mechanisms include belt drives, chain drives, linkages, valves, fans and blowers. The subject matter on mechanical components and systems covers operational principles, uses, maintenance, troubleshooting, and procedures for repair and replacement. The laboratory applications emphasize practical maintenance and installation of equipment and selection and specification of proper replacement components from manufacturers' catalogs.

FLUID POWER

The course in Fluid Power is designed to provide the student with an overview of fluid power technology and a working knowledge of each of the components used in fluid power circuits. Hydraulic and pneumatic systems will be discussed. Topics presented will include fundamentals of fluid dynamics, conventional fluid circuits and fluid power components.

INSTRUMENTATION AND CONTROLS

Instrumentation and Controls is designed to provide the student with practical knowledge and skills in the specification, use and calibration of measuring devices and the principles and applications of automatic control processes for electrical power production, heating, air conditioning and manufacturing.

COMPUTER APPLICATIONS

This course provides an introduction to the hardware and software architecture of microprocessor systems used in applications of signal processing and control. Specifically, the course covers techniques for processing both analog and digital information into and out of microcomputers and applies these techniques to real-world control problems.

INDUSTRIAL ELECTRICAL POWER AND EQUIPMENT

This course deals with the source, distribution, and use of electrical power in industrial plants. The first part of the course describes ac electrical power as it arrives at the plant substation and the electrical equipment needed to transform it to useful voltages, distribute it effectively and protect it from overcurrent conditions. Equipment typically includes transformers, switchgear, fuses and relays. The second part of the course deals with electromechanical equipment required to convert electrical power into useful, rotational mechanical energy. Equipment typically includes ac and dc motors, motor controllers and synchromechanisms.

ELECTROMECHANICAL DEVICES

Electromechanical Devices provides the student with a working knowledge of control elements in electrical circuits, transformers, motors and generators. Topics presented include switches, circuit breakers, relays, fuses, transformers, dc and ac motors and generators.

FUNDAMENTALS OF ELECTRICITY AND ELECTRONICS

This course provides the foundation for the principles of electricity and magnetism required for further study in electricity and electronics. Topics discussed include basics of electricity and magnetism, electrical charge in motion, dc circuit analysis, ac circuit analysis, magnetic circuits and devices, reactance, and impedance.

ANALOG CIRCUITS AND ACTIVE DEVICES

This course will expose the student to the most common circuit applications for analog devices. Amplifiers, oscillators and other circuits employed in industrial measurements and control are examined as well as the theory of operation behind AM, FM and SSB.

DIGITAL ELECTRONICS

This course will present the student with common digital circuits such as multivibrators, counters, shift registers and memories. Students will examine and work with bus structures, data transmission techniques, and interfacing.

DIGITAL ELECTRONICS

Presents the basis of digital electronics. Students gain knowledge of gates, flip-flops, latches, and encoders/decoders used in combinational and sequential logic circuits. Students learn and employ various numbering systems, codes, and analytical tools such as truth tables, mapping techniques, and Boolean algebra. Students will, at the conclusion of this course, be able to identify, troubleshoot, repair and modify several basic logic circuits.

DIGITAL DEVICES AND SYSTEMS

Covers the common digital circuits such as multivibrators, counters, shift registers and memories. The student will examine and work with bus structures, data-transmission techniques and interfacing.

APPENDIX 11

ASSOCIATE DEGREE PROGRAM

ACADEMIC REQUIREMENTS

GENERAL EDUCATION TRANSFER CREDITS:

24 QUARTER HOURS

(15 SEMESTER HOURS)

ENGL 104 COMPOSITION I

ENGL 134 SPEECH COMMUNICATION

MATH 104 COLLEGE ALGEBRA I

PSYC 104 GENERAL PSYCHOLOGY

PLUS 2 ELECTIVE COURSES (8 CREDITS)

FROM HUMANITIES OR FINE ARTS,

SOCIAL OR BEHAVIORAL SCIENCES,

AND MATH OR NATURAL SCIENCE

ASSOCIATE DEGREE PROGRAM

TIME/CREDIT REQUIREMENTS

CREDIT HOURS: 90-108 QUARTER HOURS

(60-70 SEMESTER HOURS)

DURATION: MINIMUM OF 6 QUARTERS

CONTACT HOURS: 27-30 HOURS PER WEEK

APPENDIX 12
TEXAS TELECOMMUNICATIONS SURVEY

Knowledge and Skill Requirements For Telecommunications Technicians

Only mark 0 if you do not know the importance of a particular task to your company. All other tasks should be marked to indicate a 1 if a skill is unimportant or not needed; 2 if a skill is of minor importance; 3 if it is of medium need; 4 if it is of major importance to the company; and 5 if a particular skill is critical to your needs.

Competencies Required of Telecommunications Technicians

0	1	2	3	4	5

The following is a list of tasks that telecommunications technicians are expected to be able to perform.

1. Solve network problems using Kirchhoff, Thevenin, Norton, Superposition and Delta-Wye theorems.
2. Set up instrumentation and measure a given voltage, current, resistance, power, and/or frequency using the appropriate VOM, DMM, oscilloscope, and/or frequency analyzer.
3. Analyze, construct, and/or troubleshoot:
   a. Series-parallel circuits
   b. Bridge circuits
4. Troubleshoot, install, repair, and/or replace electronic circuits to the:
   a. Device level
   b. Board level
   c. Component level
5. Analyze, construct, and/or troubleshoot series, parallel, or complex:
   a. RLC circuits
   b. Resonant circuits
   c. Filter circuits
   d. Polyphase circuits
   e. Amplifiers and equalization networks
6. Set up and operate:
   a. Frequency counters
   b. Signal generators
   c. Capacitor-inductor analyzers
   d. Impedance bridges
   e. Oscilloscopes

0	1	2	3	4	5	
						f. Sweep generators
						g. Spectrum analyzers
						h. Cable-fault analyzer
						7. Analyze, construct, measure characteristics of, and troubleshoot:
						a. Diode circuits
						b. Transistor circuits
						c. FET circuits
						d. Thyristor circuits
						e. SCRs
						f. TRIACs
						g. DIACs
						h. Light-emitting/detecting semiconductors
						8. Set up and use:
						a. Curve tracers
						b. Logic probes
						c. Logic analyzers
						d. Transistor testers
						9. Analyze, construct, and troubleshoot:
						a. Single-stage amplifiers
						b. Multistage amplifiers
						c. Power supplies
						d. Oscillators
						10. Analyze, troubleshoot, and repair advanced servomechanism systems.
						11. Read and sketch electronic schematics.
						12. Record data and design curves and graphs.
						13. State input and output speed, voltage and current characteristics of ten logic families and RS232C devices.
						14. Identify electrical problems encountered when interfacing between logic families and RS232C devices.
						15. Build and test interfaces between TTL and CMOS circuits.
						16. Given a standard specification, determine whether or not a representative of any of the following logic circuits is operational:
						a. Gate, buffer/driver
						b. Buffer/driver
						c. Flip-flop
						d. Counter, shift register
						e. Selector
						f. Multiplexer/demultiplexer
						g. Comparator

0	1	2	3	4	5

17. Explain the role of timing in communication; distinguish between synchronous and asynchronous transmission.
18. Describe capacity of a channel in terms of bandwidth, baud-rate and grade.
19. Describe communication made possible by simplex, half-duplex and duplex links.
20. Use a shift register as a digital multiplexer and as a demultiplexer.
21. Use an analog switch as an analog multiplexer and as a demultiplexer.
22. Build a digital and an analog multiplexed data communication system; use each system to communicate information.
23. Identify microcomputer ICs and determine function and logic from manual.
24. Locate source of static hardware difficulties in small microcomputer systems.
25. Use logic analyzer for dynamic testing of microcomputer systems.
26. Analyze, troubleshoot, and repair:
    a. ECL logic families
    b. LSI circuits
27. Analyze and troubleshoot firmware using defined hardware.
28. Analyze, construct, troubleshoot:
    a. CPUs
    b. BUS systems
    c. Memory systems
    d. Input/output ports
29. Analyze, construct and troubleshoot microprocessor applications and systems.
30. Analyze and troubleshoot microcomputer systems.
31. Breadboard A/D and D/A circuits.
32. Interface a specified microprocessor to an input/output measurement system.
33. Construct or install:
    a. Station (JKT, USOC blocks, 25-pair cable, colors)
    b. Jumper wires
    c. Punch-down techniques
34. Repair and/or replace:
    a. Station (JKT, USOC blocks, 25-pair cable, colors)
    b. Jumper wires
    c. Punch-down techniques

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0	1	2	3	4	5	
						35. Read and interpret:
						a. Attached and detached contact schematics
						b. T-drawings
						c. Office drawings
						36. Define and give standard examples using the terms:
						a. Baud
						b. Modem
						c. PBX
						37. Identify the tone-pair assignments for:
						a. DTMF
						b. MF
						38. Identify and describe the differences between the five classes of telephone offices.
						39. Discuss the various multiplexing methods employed in telephony systems.
						40. Identify the frequency allocations for RF energy as governed by:
						a. ITU
						b. FCC
						41. Match frequency ranges to banks (VLF, LF, MF, HF, VHF, UHF, and SHF).
						42. Identify and translate messages in the codes:
						a. Q-signals
						b. 10-code
						c. Baudot 5-bit code
						d. ASCII 7/8 bit code
						43. Set up and measure:
						a. VSWR
						b. Attenuation
						c. Insertion loss
						44. Troubleshoot and replace:
						a. Klystron tubes
						b. TWTs
						c. Magnetrons
						d. Varactors
						e. Gunn diodes
						f. Tunnel diodes
						g. Step-recovery diodes
						h. YIG tuned
						45. Identify, set up, tune and test waveguide transmission lines.
						46. Troubleshoot, repair and/or replace transmission-line sections.

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0	1	2	3	4	5	
						47. Use Smith chart for impedance calculations with transmission lines.
						48. Select, set up, connect, troubleshoot and repair the following antennas:
						a. Monopole
						b. Dipole
						c. Folded dipole
						d. Logarithmically periodic
						e. Conical
						f. Helical
						g. Loop
						h. Rhombic
						i. Slot
						j. Horn
						49. Describe signal propagation effects for antennas with respect to reflector elements and parasitic elements.
						50. Troubleshoot:
						a. HF transmitters
						b. HF receivers
						c. Single-sideband transceiver
						d. With the two-tone test
						51. Repair and align:
						a. Linear amplifiers
						b. Video transmission equipment
						52. Measure, align and test:
						a. SSB/CW/AM receiver performance
						b. Microwave lines
						c. FM transmitter
						53. Analyze frequency synthesizers:
						a. PLL type
						b. LSI type
						54. Perform or check calibration of:
						a. Test instrument meters
						b. Frequency counters
						c. Spectrum analyzers
						55. For optical fibers measure:
						a. Transmission loss
						b. Scattering and absorption loss
						c. Accuracy
						d. Length (via reflectometry methods)

0	1	2	3	4	5	
						e. Spectral attenuation
						f. Frequency response
						g. Refractive index profile
						h. Impulse response
						56. Splice optical fibers where/when required.
						57. Use connectors for alignment and coupling of light source into fiber.
						58. Install, troubleshoot, and replace:
						a. LED light sources
						b. Solid-state lasers
						c. Electro-optic modulators
						d. Acousto-optic devices
						e. Photodetectors
						59. Recognize resistor values using the standard resistor color code and identify different types of resistors such as thermistors, voltage-dependent resistors, variable resistors and others.
						60. Recognize and test common electronic components such as capacitors and inductors, and determine their values by common markings.
						61. Determine power, impedance, admittance, susceptance and other applicable values of complex series and/or parallel R-C-L Circuits.
						62. Analyze dc and ac motors and generators.
						63. Identify/name families of linear and logic integrated circuits.
						64. Analyze function and operation, construct, measure, and troubleshoot commonly used semiconductor circuits.
						a. Power supplies
						b. AF/RF amplifiers
						c. AF/RF oscillators, generators, clocks
						d. Wave-shaping circuits
						e. Filters
						65. Demonstrate knowledge of:
						a. Drafting techniques
						b. Lettering procedures
						c. Use of drafting instruments
						66. Identify and classify items as being either analog or digital in nature.
						67. Convert between binary, octal, hexadecimal, decimal and BCD number systems.
						68. Analyze, design and troubleshoot digital circuits using logic gates and flip-flops.

0	1	2	3	4	5	
						69. Use Boolean algebra to express logic operations.
						70. Given a standard specification, determine whether or not a representative of any of the following logic circuits is operational:
						a. Gate, buffer/driver
						b. Buffer/driver
						c. Flip-flop
						d. Counter, shift register
						e. Multiplexer/demultiplexer
						f. Comparator
						71. Analyze, construct and troubleshoot sequential logic circuits such as binary and BCD counters and shift registers.
						72. Identify, analyze and troubleshoot various types of semiconductor memories: RAMs, ROMs, etc.
						73. Analyze and troubleshoot various types of data convertors.
						74. Build and test interfaces between TTL and CMOS circuits.
						75. Analyze, construct, troubleshoot:
						a. Memory systems and address decoders
						b. Input/output ports
						c. A to D and D to A convertors
						76. Construct, analyze and troubleshoot circuits containing operational amplifiers.
						77. Measure and compute common OP-AMP parameters.
						78. Discuss optical terms and concepts related to lasers and fiber optics.
						79. Recognize safety hazards associated with all types of lasers.
						80. Draw dc and ac signal paths on electronic block diagrams, schematics, and printed circuit board layouts.
						81. Design PC board layouts from schematics.
						82. Construct PC boards using manual artwork, dry transfer on copper-clad board, and photographic methods.
						83. Troubleshoot, install, repair, and/or replace electronic circuits on PC boards at component level.
						84. Protect PC board by tin plating and by using chemical sprays.
						85. Repair damaged PC board lands.
						86. Discuss and demonstrate image: systems, capture, processing and display.

0	1	2	3	4	5	
						87. Analyze, configure, troubleshoot and repair the following systems: a. Videcon and CCD cameras
						b. Video monitors
						c. Video LCD displays
						d. Video scanners
						88. Analyze and test digital video processors.
						89. Analyze, troubleshoot and repair various video recorders.
						90. Discuss and test digital recorders.
						91. Process, manipulate and convert various image formats.
						92. Construct and test basic CW transmitter.
						93. Construct basic receiver to detect AM, SSB, and FM.
						94. Analyze transmitted signals in both the time and frequency domains.
						95. Measure output power by direct and indirect methods.
						96. Measure signal, sensitivity, selectivity and signal-to-noise ratio in receivers.
						97. Analyze frequency synthesizers.
						98. Identify and analyze a variety of common types of coaxial transmission lines with respect to physical construction, impedance, velocity factor and line loss.
						99. Identify, install and test common types of coaxial connectors.
						100. Discuss AM and FM broadcast systems, classifications, power, components, interconnects, antenna systems, tests and logs.
						101. Demonstrate technical proficiency regarding troubleshooting, tuning, power measurements, studio and transmitter maintenance, proof of performance tests and FCC requirements.
						102. Analyze and demonstrate thorough knowledge of various network, STL, and satellite interconnects and levels.
						103. Demonstrate satisfactory ability to operate test equipment associated with broadcast.
						104. Discuss and perform calculations required for microwave transmission.
						105. Operate, tune and adjust microwave sources.
						106. Calculate microwave antenna parameters.

0	1	2	3	4	5

107. Measure and record the following:
    a. Power and frequency
    b. Receive carrier levels
    c. Deviation using bessel null function
108. Exhibit proficiency in radar operation and testing.
109. Orient and test both azel and polar-mount satellite antennas.
110. Using a commercial mobile transceiver and service manual:
    a. Follow by drawing with color pencils the dc and ac signal tracks on block diagram, schematic, PC board layouts.
    b. Analyze the function of every circuit by measuring the dc and ac signals throughout the transceiver with a DMM, oscilloscope, modulated RF signal generator and frequency counter.
    c. Tune all stages to service manual specifications.
111. Analyze repeater operations. Tune and adjust PL encoder/decoder, deviation tracking and duplexers.
112. Analyze, set signal levels and tune:
    a. Tone paging, alert and control systems.
    b. Telephone and RF link interconnects
113. Analyze the operation of:
    a. Trunking systems
    b. Cellular systems
114. Demonstrate knowledge of rules and regulations, franchise, and copyright.
115. Test, troubleshoot and repair processors, demodulators, modulators, line amplifiers (with/without AGC), extenders, and directional taps.
116. Set up CATV system levels, verify and log same.
117. Perform FCC system proof tests.
118. Analyze and lay out small CATV plant.
119. Discuss types and classes of licensing, review subject material covered, take sample tests and critique same.
120. Demonstrate ability to understand written problems.

APPENDIX 13
INDUSTRY REPRESENTATIVES

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APPENDIX 14

Texas State Technical Institute - Sweetwater Curriculum Competency versus Course Matrix

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	COLLEGE ALGEBRA I	PLANE TRIGONOMETRY	COLLEGE PHYSICS	ELECTIVE ORIENT. OR SAFETY, ETC.	BASIC ELECTRONIC PRINCIPLES	COMPOSITION I	SPEECH COMMUNICATIONS	COMPUTER FAMILIARIZATION (BASIC)	INTERMEDIATE ELECTRONIC PRINCIPLES	GENERAL PSYCHOLOGY	ELECTRONIC DRAFTING	SOLID STATE DEVICES AND CIRCUITS I	SOLID STATE DEVICES AND CIRCUITS II	DIGITAL I	DIGITAL II	LASER AND FIBER OPTIC PRINCIPLES	LINEAR IC's (OP-AMPS)
1. Solve network problems using Kirchhoff, Thevenin, Norton, Superposition and Delta-Wye theorems.									x								
2. Set up instrumentation and measure a given voltage, current, resistance, power, and/or frequency using the appropriate VOM, DVM, oscilloscope, and/or frequency analyzer.					x				x			x		x			x
3. Analyze, construct, and/or troubleshoot:																	
a. Series-parallel circuits					x				x								
b. Bridge circuits					x							x					x
4. Troubleshoot, install, repair, and/or replace electronic circuits to the:																	
a. Device level												x	x				x
b. Board level																	
b. Component level																	
5. Analyze, construct, and/or troubleshoot series, parallel, or complex:																	
a. RLC circuits									x								x
b. Resonant circuits																	
c. Filter circuits									x								
d. Polyphase circuits					x				x								
e. Amplifiers and equalization networks																	
6. Set up and operate:																	
a. Frequency counters					x				x				x		x		
b. Signal generators					x												
c. Capacitor-inductor analyzers					x				x								
d. Impedance bridges					x												
e. Oscilloscopes					x				x			x		x	x		
f. Sweep generators																	
g. Spectrum analyzers																	
h. Cable-fault analyzer																x	
7. Analyze, construct, measure characteristics of, and troubleshoot:																	
a. Diode circuits												x	x	x			x
b. Transistor circuits												x	x				
c. FET circuits												x	x				
d. Thyristor circuits												x	x				x
e. SCRs												x	x				x
f. TRIACs												x	x				
g. DIACs												x	x				
h. Light-emitting/detecting semiconductors												x	x				
8. Set up and use:																	
a. Curve tracers																	x
b. Logic probes												x		x			
c. Logic analyzers												x		x			
d. Transistor testers												x					
9. Analyze, construct, and troubleshoot:																	
a. Single-stage amplifiers													x				
b. Multistage amplifiers													x				
c. Power supplies													x				
d. Oscillators													x				

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	MICROPROCESSOR I	MICROPROCESSOR II	IMAGE SYSTEMS (VIDEO)	PRINTED CIRCUIT BOARDS	BASIC TRANSMITTERS AND RECEIVERS	ANTENNA SYSTEMS	ADVANCED IMAGE PROCESSING	ANALOG AND DIGITAL SYSTEMS WITH INTERFACE	MOBILE AND FIXED RADIO	TELEPHONE SYSTEMS	CABLE TELEVISION	BROADCAST RADIO AND TELEVISION	MICROWAVE AND SATELLITE	ELECTRONIC TECHNICIAN CERTIFICATION
1. Solve network problems using Kirchhoff, Thevenin, Norton, Superposition and Delta-Wye theorems.														
2. Set up instrumentation and measure a given voltage, current, resistance, power, and/or frequency using the appropriate VOM, DVM, oscilloscope, and/or frequency analyzer.														
3. Analyze, construct, and/or troubleshoot:														
a. Series-parallel circuits														
b. Bridge circuits														
4. Troubleshoot, install, repair, and/or replace electronic circuits to the:														
a. Device level														
b. Board level		•	•		•			•	•	•	•	•	•	
b. Component level		•	•		•			•	•	•	•	•	•	
5. Analyze, construct, and/or troubleshoot series, parallel, or complex:														
a. RLC circuits					•									
b. Resonant circuits			•		•									
c. Filter circuits					•								•	
d. Polyphase circuits					•									
e. Amplifiers and equalization networks					•							•	•	
6. Set up and operate:														
a. Frequency counters					•									
b. Signal generators					•	•		•		•			•	
c. Capacitor-inductor analyzers					• •	• •								
d. Impedance bridges														
e. Oscilloscopes								•						
f. Sweep generators					•			•			•	•		
g. Spectrum analyzers					•				•		•			
h. Cable-fault analyzer										•				
7. Analyze, construct, measure characteristics of, and troubleshoot:														
a. Diode circuits														
b. Transistor circuits														
c. FET circuits					•									
d. Thyristor circuits														
e. SCRs														
f. TRIACs														
g. DIACs														
h. Light-emitting/detecting semiconductors														
8. Set up and use:														
a. Curve tracers														
b. Logic probes	•													
c. Logic analyzers	•													
d. Transistor testers														
9. Analyze, construct, and troubleshoot:														
a. Single-stage amplifiers					•									
b. Multistage amplifiers					•									
c. Power supplies					•									
d. Oscillators					•									

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JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	COLLEGE ALGEBRA I	PLANE TRIGONOMETRY	COLLEGE PHYSICS I	ELECTIVE ORIENT. OR SAFETY, ETC.	BASIC ELECTRONIC PRINCIPLES	COMPOSITION I	SPEECH COMMUNICATIONS	COMPUTER FAMILIARIZATION (BASIC)	INTERMEDIATE ELECTRONIC PRINCIPLES	GENERAL PSYCHOLOGY	ELECTRONIC DRAFTING	SOLID STATE DEVICES AND CIRCUITS I	SOLID STATE DEVICES AND CIRCUITS II	DIGITAL I	DIGITAL II	LASER AND FIBER OPTIC PRINCIPLES	LINEAR IC's (OP-AMPS)
10. Analyze, troubleshoot, and repair advanced servomechanism systems.																	
11. Read and sketch electronic schematics.											x						
12. Record data and design curves and graphs.											x	x	x				
13. State input and output speed, voltage and current characteristics of two logic families and RS232C devices.															x		
14. Identify electrical problems encountered when interfacing between logic families and RS232C devices.															x		
15. Build and test interfaces between TTL and CMOS circuits.												x			x		
16. Given a standard specification, determine whether or not a representative of any of the following logic circuits is operational:																	
a. Gate, buffer/driver														x			
b. Buffer/driver														x			
c. Flip-flop														x			
d. Counter, shift register															x		
e. Selector															x		
f. Multiplexer/demultiplexer															x		
g. Comparator															x		
17. Explain the role of timing in communications; distinguish between synchronous and asynchronous transmission.															x		
18. Describe capacity of a channel in terms of bandwidth, baud-rate and grade.																	
19. Describe communication mode possible by simplex, half-duplex and duplex links.																	
20. Use a shift register as a digital multiplexer and as a demultiplexer.															x		
21. Use an analog switch as an analog multiplexer and as a demultiplexer.																	
22. Build a digital and an analog multiplexed data communication system; use each system to communicate information.																	
23. Identify microcomputer ICs and determine function and logic from manual.																	
24. Locate source of static hardware difficulties in small microcomputer systems.																	
25. Use logic analyzer for dynamic testing of microcomputer systems.														x			

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	MICROPROCESSOR I	MICROPROCESSOR II	IMAGE SYSTEMS (VIDEO)	PRINTED CIRCUIT BOARDS	BASIC TRANSMITTERS AND RECEIVERS	ANTENNA SYSTEMS	ADVANCED IMAGE PROCESSING	ANALOG AND DIGITAL SYSTEMS WITH INTERFACE	MOBILE AND FIXED RADIO	TELEPHONE SYSTEMS	CABLE TELEVISION	BROADCAST RADIO AND TELEVISION	MICROWAVE AND SATELLITE	ELECTRONIC TECHNICIAN CERTIFICATION
10. Analyze, troubleshoot, and repair advanced servomechanism systems.						x								
11. Read and sketch electronic schematics.				x	x									
12. Record data and design curves and graphs.														
13. State input and output speed, voltage and current characteristics of ten logic families and RS232C devices.								x						
14. Identify electrical problems encountered when interfacing between logic families and RS232C devices.	x							x						
15. Build and test interfaces between TTL and CMOS circuits.		x												
16. Given a standard specification, determine whether or not a representative of any of the following logic circuits is operational:														
a. Gate, buffer/driver	x													
b. Buffer/driver	x													
c. Flip-flop	x													
d. Counter, shift register	x													
e. Selector	x													
f. Multiplexer/demultiplexer	x													
g. Comparator	x				x									
17. Explain the role of timing in communication; distinguish between synchronous and asynchronous transmission.		x						x		x				
18. Describe capacity of a channel in terms of bandwidth, baud-rate and grade.								x		x				
19. Describe communication made possible by simplex, half-duplex and duplex links.								x		x				
20. Use a shift register as a digital multiplexer and as a demultiplexer.								x						
21. Use an analog switch as an analog multiplexer and as a demultiplexer.								x						
22. Build a digital and an analog multiplexed data communication system; use each system to communicate information.								x						
23. Identify microcomputer ICs and determine function and logic from manual.	x	x												
24. Locate source of static hardware difficulties in small microcomputer systems.		x												
25. Use logic analyzer for dynamic testing of microcomputer systems.		x						x						

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	COLLEGE ALGEBRA I	PLANE TRIGONOMETRY	COLLEGE PHYSICS	ELECTIVE ORIENT. OR SAFETY, ETC.	BASIC ELECTRONIC PRINCIPLES	COMPOSITION I	SPEECH COMMUNICATIONS	COMPUTER FAMILIARIZATION (BASIC)	INTERMEDIATE ELECTRONIC PRINCIPLES	GENERAL PSYCHOLOGY	ELECTRONIC DRAFTING	SOLID STATE DEVICES AND CIRCUITS I	SOLID STATE DEVICES AND CIRCUITS II	DIGITAL I	DIGITAL II	LASER AND FIBER OPTIC PRINCIPLES	LINEAR IC's (OP-AMPS)
26. Analyze, troubleshoot, and repair: a. ECL logic families b. LSI circuits															■ ■		
27. Analyze and troubleshoot firmware using defined hardware.																	
28. Analyze, construct, troubleshoot: a. CPUs b. BUS systems c. Memory systems d. Input/output ports																	
29. Analyze, construct and troubleshoot microprocessor applications and systems.																	
30. Analyze and troubleshoot microcomputer systems.																	
31. Breadboard A/D and D/A circuits.															■		
32. Interface a specified microprocessor to an input/output measurement system.																	
33. Construct or install: a. Station (JKT, USOC blocks, 25-pair cable, colors) b. Jumper wires c. Punch-down techniques																	
34. Repair and/or replace: a. Station (JKT, USOC blocks, 25-pair cable, colors) b. Jumper wires c. Punch-down techniques																	
35. Read and interpret: a. Attached and detached contact schematics b. T-drawings c. Office drawings											■						
36. Define and give standard examples using the terms: a. Baud b. Modem c. PBX																	
37. Identify the tone-pair assignments for: a. DTMF b. MF																	
38. Identify and describe the differences between the five classes of telephone offices.																	
39. Discuss the various multiplexing methods employed in telephony systems.																	
40. Identify the frequency allocations for RF energy as governed by: a. ITU b. FCC																	

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	MICROPROCESSOR I	MICROPROCESSOR II	IMAGE SYSTEMS (VIDEO)	PRINTED CIRCUIT BOARDS	BASIC TRANSMITTERS AND RECEIVERS	ANTENNA SYSTEMS	ADVANCED IMAGE PROCESSING	ANALOG AND DIGITAL SYSTEMS WITH INTERFACE	MOBILE AND FIXED RADIO	TELEPHONE SYSTEMS	CABLE TELEVISION	BROADCAST RADIO AND TELEVISION	MICROWAVE AND SATELLITE	ELECTRONIC TECHNICIAN CERTIFICATION
26. Analyze, troubleshoot, and repair:														
a. ECL logic families		x												
b. LSI circuits		x												
27. Analyze and troubleshoot firmware using defined hardware.		x												
28. Analyze, construct, troubleshoot:														
a. CPUs		x												
b. BUS systems		x												
c. Memory systems		x												
d. Input/output ports		x												
29. Analyze, construct and troubleshoot microprocessor applications and systems.		x												
30. Analyze and troubleshoot microcomputer systems.		x												
31. Breadboard A/D and D/A circuits.		x		x				x						
32. Interface a specified microprocessor to an input/output measurement system.		x												
33. Construct or install:														
a. Station (JKT, UBOC blocks, 25-pair cable, colors)										x				
b. Jumper wires										x				
c. Punch-down techniques										x				
34. Repair and/or replace:														
a. Station (JKT, UBOC blocks, 25-pair cable, colors)										x				
b. Jumper wires										x				
c. Punch-down techniques										x				
35. Read and interpret:														
a. Attached and detached contact schematics										x				
b. T-drawings										x				
c. Office drawings										x				
36. Define and give standard examples using the terms:														
a. Baud	x									x				
b. Modem		x								x				
c. PBX										x				
37. Identify the tone-pair assignments for:														
a. DTMF								x		x				
b. MF								x		x				
38. Identify and describe the differences between the five classes of telephone offices.										x				
39. Discuss the various multiplexing methods employed in telephony systems.										x				
40. Identify the frequency allocations for RF energy as governed by:														
a. ITU									x	x		x	x	x
b. FCC									x	x		x	x	x

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	COLLEGE ALGEBRA I	PLANE TRIGONOMETRY	COLLEGE PHYSICS I	ELECTIVE ORIENT. OR SAFETY, ETC.	BASIC ELECTRONIC PRINCIPLES	COMPOSITION I	SPEECH COMMUNICATIONS	COMPUTER FAMILIARIZATION (BASIC)	INTERMEDIATE ELECTRONIC PRINCIPLES	GENERAL PSYCHOLOGY	ELECTRONIC DRAFTING	SOLID STATE DEVICES AND CIRCUITS I	SOLID STATE DEVICES AND CIRCUITS II	DIGITAL I	DIGITAL II	LASER AND FIBER OPTIC PRINCIPLES	LINEAR IC's (OP-AMPS)
41. Match frequency ranges to bands (VLF, LF, MF, HF, VHF, UHF, and SHF).																	
42. Identify and translate messages in the codes: a. Q-signals b. 10-code c. Baudot 5-bit code d. ASCII 7/8 bit code e. EBCDIC																	
43. Set up and measure: a. VSWR b. Attenuation c. Insertion loss																	
44. Troubleshoot and replace: a. Klystron tubes b. TWTs c. Magnetrons d. Varactors e. Gunn diodes f. Tunnel diodes g. Step-recovery diodes h. YIG tuned																	
45. Identify, set up, tune and test waveguide transmission lines.																	
46. Troubleshoot, repair and/or replace transmission-line sections.																	
47. Use Smith chart for impedance calculations with transmission lines.																	
48. Select, set up, connect, troubleshoot and repair the following antennas: a. Monopole b. Dipole c. Folded dipole d. Logarithmically periodic e. Conical f. Helical g. Loop h. Rhombic i. Slot j. Horn																	
49. Describe signal propagation effects for antennas with respect to reflector elements and parasitic elements.																	
50. Troubleshoot: a. AF transmitters b. RF receivers c. Single-sideband transceiver d. With the two-tone test																	
51. Repair and align: a. Linear amplifiers b. Video transmission equipment																	
52. Measure, align and test: a. SSB/CW/AM receiver performance b. Microwave lines c. FM transmitter																	

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	MICROPROCESSOR I	MICROPROCESSOR II	IMAGE SYSTEMS (VIDEO)	PRINTED CIRCUIT BOARDS	BASIC TRANSMITTERS AND RECEIVERS	ANTENNA SYSTEMS	ADVANCED IMAGE PROCESSING	ANALOG AND DIGITAL SYSTEMS WITH INTERFACE	MOBILE AND FIXED RADIO	TELEPHONE SYSTEMS	CABLE TELEVISION	BROADCAST RADIO AND TELEVISION	MICROWAVE AND SATELLITE	ELECTRONIC TECHNICIAN CERTIFICATION
41. Match frequency ranges to bands (VLF, LF, MF, HF, VHF, UHF, and SHF).									x					x
42. Identify and translate messages in the codes:														
a. Q-signals					x									
b. 10-code									x					
c. Baudot 5-bit code														
d. ASCII 7/8 bit code		x												
e. EBCDIC		x												
43. Set up and measure:														
a. VSWR						x			x				x	
b. Attenuation						x			x				x	
c. Insertion loss						x			x				x	
44. Troubleshoot and replace:														
a. Klystron tubes													x	
b. TWTs													x	
c. Magnetrons													x	
d. Varactors													x	
e. Gunn diodes													x	
f. Tunnel diodes													x	
g. Step-recovery diodes														
h. YIG tuned														
45. Identify, set up, tune and test waveguide transmission lines.													x	
46. Troubleshoot, repair and/or replace transmission-line sections.					x	x						x	x	
47. Use Smith chart for impedance calculations with transmission lines.						x								
48. Select, set up, connect, troubleshoot and repair the following antennas:														
a. Monopole						x								
b. Dipole						x								
c. Folded dipole						x								
d. Logarithmically periodic						x								
e. Conical						x								
f. Helical						x								
g. Loop						x								
h. Rhombic						x								
i. Slot						x								
j. Horn						x							x	
49. Describe signal propagation effects for antennas with respect to reflector elements and parasitic elements.						x							x	
50. Troubleshoot:														
a. HF transmitters					x									
b. HF receivers														
c. Single-sideband transceiver														
d. With the two-tone test														
51. Repair and align:														
a. Linear amplifiers					x									
b. Video transmission equipment			x				x							
52. Measure, align and test:														
a. SSB/CW/AM receiver performance					x									
b. Microwave lines													x	
c. FM transmitter					x									

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	COLLEGE ALGEBRA I	PLANE TRIGONOMETRY	COLLEGE PHYSICS	ELECTIVE ORIENT. OR SAFETY, ETC.	BASIC ELECTRONIC PRINCIPLES	COMPOSITION I	SPEECH COMMUNICATIONS	COMPUTER FAMILIARIZATION (BASIC)	INTERMEDIATE ELECTRONIC PRINCIPLES	GENERAL PSYCHOLOGY	ELECTRONIC DRAFTING	SOLID STATE DEVICES AND CIRCUITS I	SOLID STATE DEVICES AND CIRCUITS II	DIGITAL I	DIGITAL II	LASER AND FIBER OPTIC PRINCIPLES	LINEAR IC's (OP-AMPS)
53. Analyze frequency synthesizers:																	
a. PLL type															x		
b. LSI type															x		
54. Perform or check calibration of:																	
a. Test instrument meters					x												
b. Frequency counters																	
c. Spectrum analyzers																	
55. For optical fibers measure:																	
a. Transmission loss																x	
b. Scattering and absorption loss																x	
c. Accuracy																x	
d. Length (via reflectometry methods)																x	
e. Spectral attenuation																x	
f. Frequency response																x	
g. Refractive index profile																x	
h. Impulse response																x	
56. Splice optical fibers where/when required.																x	
57. Use connectors for alignment and coupling of light source into fiber.																x	
58. Install, troubleshoot, and replace:																	
a. LED light sources																x	
b. Solid-state lasers																x	
c. Electro-optic modulators																x	
d. Acousto-optic devices																x	
e. Photodetectors																x	
59. Recognize resistor values using the standard resistor color code and identify different types of resistors such as thermistors, voltage-dependent resistors, variable resistors and others.					x				x								
60. Recognize and test common electronic components such as capacitors and inductors, and determine their values by common markings.					x				x								
61. Determine power, impedance, admittance, susceptance and other applicable values of complex series and/or parallel R-C-L Circuits.					x				x								
62. Analyze dc and ac motors and generators.									x								
63. Identify/name families of linear and logic integrated circuits.												x	x	x	x		x

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	MICROPROCESSOR I	MICROPROCESSOR II	IMAGE SYSTEMS (VIDEO)	PRINTED CIRCUIT BOARDS	BASIC TRANSMITTERS AND RECEIVERS	ANTENNA SYSTEMS	ADVANCED IMAGE PROCESSING	ANALOG AND DIGITAL SYSTEMS WITH INTERFACE	MOBILE AND FIXED RADIO	TELEPHONE SYSTEMS	CABLE TELEVISION	BROADCAST RADIO AND TELEVISION	MICROWAVE AND SATELLITE	ELECTRONIC TECHNICIAN CERTIFICATION
53. Analyze frequency synthesizers:														
a. PLL type					x								x	
b. LSI type					x								x	
54. Perform or check calibration of:														
a. Test instrument meters														
b. Frequency counters					x				x		x	x	x	
c. Spectrum analyzers					x				x		x	x	x	
55. For optical fibers measure:														
a. Transmission loss														
b. Scattering and absorption loss														
c. Accuracy														
d. Length (via reflectometry methods)														
e. Spectral attenuation														
f. Frequency response														
g. Refractive index profile														
h. Impulse response														
56. Splice optical fibers where/when required.														
57. Use connectors for alignment and coupling of light source into fiber.														
58. Install, troubleshoot, and replace:														
a. LED light sources														
b. Solid-state lasers														
c. Electro-optic modulators														
d. Acousto-optic devices														
e. Photodetectors														
59. Recognize resistor values using the standard resistor color code and identify different types of resistors such as thermistors, voltage-dependent resistors, variable resistors and others.														
60. Recognize and test common electronic components such as capacitors and inductors, and determine their values by common markings.														
61. Determine power, impedance, admittance, susceptance and other applicable values of complex series and/or parallel R-C-L Circuits.														
62. Analyze dc and ac motors and generators.														
63. Identify/name families of linear and logic integrated circuits.														

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	COLLEGE ALGEBRA I	PLANE TRIGONOMETRY	COLLEGE PHYSICS	ELECTIVE ORIENT. OR SAFETY, ETC.	BASIC ELECTRONIC PRINCIPLES	COMPOSITION I	SPEECH COMMUNICATIONS	COMPUTER FAMILIARIZATION (BASIC)	INTERMEDIATE ELECTRONIC PRINCIPLES	GENERAL PSYCHOLOGY	ELECTRONIC DRAFTING	SOLID STATE DEVICES AND CIRCUITS I	SOLID STATE DEVICES AND CIRCUITS II	DIGITAL I	DIGITAL II	LASER AND FIBER OPTIC PRINCIPLES	LINEAR IC's (OP-AMPS)
64. Analyze function and operation, construct, measure, and troubleshoot commonly used semiconductor circuits.																	
a. Power supplies													▪				
b. AF/RF amplifiers													▪				
c. AF/RF oscillators, generators, clocks													▪				
d. Wave-shaping circuits																	▪
e. Filters																	▪
65. Demonstrate knowledge of:																	
a. Drafting techniques											▪						
b. Lettering procedures											▪						
c. Use of drafting instruments											▪						
66. Identify and classify items as being either analog or digital in nature.													▪				
67. Convert between binary, octal, hexadecimal, decimal and BCD number systems.														▪			
68. Analyze, design and troubleshoot digital circuits using logic gates and flip-flops.														▪	▪		
69. Use Boolean algebra to express logic operations.															▪		
70. Given a standard specification, determine whether or not a representative of any of the following logic circuits is operational:																	
a. Gate, buffer/driver															▪		
b. Buffer/driver															▪		
c. Flip-flop															▪		
d. Counter, shift register															▪		
e. Multiplexer/demultiplexer															▪		
f. Comparator															▪		
71. Analyze, construct and troubleshoot sequential logic circuits such as binary and BCD counters and shift registers.															▪		
72. Identify, analyze and troubleshoot various types of semiconductor memories: RAMs, ROMs, etc.															▪		
73. Analyze and troubleshoot various types of data converters.															▪		
74. Build and test interfaces between TTL and CMOS circuits.															▪		
75. Analyze, construct, troubleshoot:																	
a. Memory systems and address decoders																	
b. Input/output ports																	
c. A to D and D to A converters															▪		

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	MICROPROCESSOR I	MICROPROCESSOR II	IMAGE SYSTEMS (VIDEO)	PRINTED CIRCUIT BOARDS	BASIC TRANSMITTERS AND RECEIVERS	ANTENNA SYSTEMS	ADVANCED IMAGE PROCESSING	ANALOG AND DIGITAL SYSTEMS WITH INTERFACE	MOBILE AND FIXED RADIO	TELEPHONE SYSTEMS	CABLE TELEVISION	BROADCAST RADIO AND TELEVISION	MICROWAVE AND SATELLITE	ELECTRONIC TECHNICIAN CERTIFICATION
64. Analyze function and operation, construct, measure, and troubleshoot commonly used semiconductor circuits.														
a. Power supplies					x									
b. AF/RF amplifiers					x									
c. AF/RF oscillators, generators, clocks					x									
d. Wave-shaping circuits					x									
e. Filters					x									
65. Demonstrate knowledge of:														
a. Drafting techniques														
b. Lettering procedures														
c. Use of drafting instruments														
66. Identify and classify items as being either analog or digital in nature.								x						
67. Convert between binary, octal, hexadecimal, decimal and BCD number systems.	x													
68. Analyze, design and troubleshoot digital circuits using logic gates and flip-flops.														
69. Use Boolean algebra to express logic operations.														
70. Given a standard specification, determine whether or not a representative of any of the following logic circuits is operational:														
a. Gate, buffer/driver	x													
b. Buffer/driver	x													
c. Flip-flop	x													
d. Counter, shift register	x													
e. Multiplexer/demultiplexer	x													
f. Comparator	x													
71. Analyze, construct and troubleshoot sequential logic circuits such as binary and BCD counters and shift registers.														
72. Identify, analyze and troubleshoot various types of semiconductor memories: RAMs, ROMs, etc.		x												
73. Analyze and troubleshoot various types of data convertors.		x						x						
74. Build and test interfaces between TTL and CMOS circuits.								x						
75. Analyze, construct, troubleshoot:														
a. Memory systems and address decoders		x												
b. Input/output ports		x						x						
c. A to D and D to A convertors		x						x						

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	COLLEGE ALGEBRA I	PLANE TRIGONOMETRY	COLLEGE PHYSICS	ELECTIVE ORIENT. OR SAFETY, ETC.	BASIC ELECTRONIC PRINCIPLES	COMPOSITION I	SPEECH COMMUNICATIONS	COMPUTER FAMILIARIZATION (BASIC)	INTERMEDIATE ELECTRONIC PRINCIPLES	GENERAL PSYCHOLOGY	ELECTRONIC DRAFTING	SOLID STATE DEVICES AND CIRCUITS I	SOLID STATE DEVICES AND CIRCUITS II	DIGITAL I	DIGITAL II	LASER AND FIBER OPTIC PRINCIPLES	LINEAR IC's (OP-AMPS)
76. Construct, analyze and troubleshoot circuits containing operational amplifiers.													x				x
77. Measure and compute common OP-AMP parameters.																	x
78. Discuss optical terms and concepts related to lasers and fiber optics.																x	
79. Recognize safety hazards associated with all types of lasers.																x	
80. Draw dc and ac signal paths on electronic block diagrams, schematics, and printed circuit board layouts.											x						
81. Design PC board layouts from schematics.																	
82. Construct PC boards using manual artwork, dry transfer on copper-clad board, and photographic methods.																	
83. Troubleshoot, install, repair, and/or replace electronic circuits on PC boards at component level.																	
84. Protect PC board by tin plating and by using chemical sprays.																	
85. Repair damaged PC board lands.																	
86. Discuss and demonstrate image systems, capture, processing and display.																	
87. Analyze, configure, troubleshoot and repair the following systems: a. Vidicon and CCD cameras b. Video monitors c. Video LCD displays d. Video scanners																	
88. Analyze and test digital video processors.																	
89. Analyze, troubleshoot and repair various video recorders.																	
90. Discuss and test digital recorders.																	
91. Process, manipulate and convert various image formats.																	
92. Construct and test basic CW transmitter.																	
93. Construct basic receiver to detect AM, SSB, and FM.																	
94. Analyze transmitted signals in both the time and frequency domains.																	

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	MICROPROCESSOR I	MICROPROCESSOR II	IMAGE SYSTEMS (VIDEO)	PRINTED CIRCUIT BOARDS	BASIC TRANSMITTERS AND RECEIVERS	ANTENNA SYSTEMS	ADVANCED IMAGE PROCESSING	ANALOG AND DIGITAL SYSTEMS WITH INTERFACE	MOBILE AND FIXED RADIO	TELEPHONE SYSTEMS	CABLE TELEVISION	BROADCAST RADIO AND TELEVISION	MICROWAVE AND SATELLITE	ELECTRONIC TECHNICIAN CERTIFICATION
76. Construct, analyze and troubleshoot circuits containing operational amplifiers.														
77. Measure and compute common OP-AMP parameters.														
78. Discuss optical terms and concepts related to lasers and fiber optics.														
79. Recognize safety hazards associated with all types of lasers.														
80. Draw dc and ac signal paths on electronic block diagrams, schematics, and printed circuit board layouts.				*	*				*					
81. Design PC board layouts from schematics.				*										
82. Construct PC boards using manual artwork, dry transfer on copper-clad board, and photographic methods.				*										
83. Troubleshoot, install, repair, and/or replace electronic circuits on PC boards at component level.				*										
84. Protect PC board by tin plating and by using chemical sprays.				*										
85. Repair damaged PC board lands.				*					*					
86. Discuss and demonstrate image systems, capture, processing and display.			*											
87. Analyze, configure, troubleshoot and repair the following systems:														
a. Videcon and CCD cameras			*				*							
b. Video monitors			*				*							
c. Video LCD displays			*				*							
d. Video scanners			*				*							
88. Analyze and test digital video processors.			*				*							
89. Analyze, troubleshoot and repair various video recorders.							*							
90. Discuss and test digital recorders.			*				*							
91. Process, manipulate and convert various image formats.			*				*							
92. Construct and test basic CW transmitter.					*									
93. Construct basic receiver to detect AM, SSB, and FM.					*									
94. Analyze transmitted signals in both the time and frequency domains.					*									

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	COLLEGE ALGEBRA I	PLANE TRIGONOMETRY	COLLEGE PHYSICS	ELECTIVE ORIENT. OR SAFETY, ETC.	BASIC ELECTRONIC PRINCIPLES	COMPOSITION I	SPEECH COMMUNICATIONS	COMPUTER FAMILIARIZATION (BASIC)	INTERMEDIATE ELECTRONIC PRINCIPLES	GENERAL PSYCHOLOGY	ELECTRONIC DRAFTING	SOLID STATE DEVICES AND CIRCUITS I	SOLID STATE DEVICES AND CIRCUITS II	DIGITAL I	DIGITAL II	LASER AND FIBER OPTIC PRINCIPLES	LINEAR IC's (OP-AMPS)
95. Measure output power by direct and indirect methods.																	
96. Measure signal, sensitivity, selectivity and signal-to-noise ratio in receivers.																	
97. Analyze frequency synthesizers.																	
98. Identify and analyze a variety of common types of coaxial transmission lines with respect to physical construction, impedance, velocity factor and line loss.																	
99. Identify, install and test common types of coaxial connectors.																	
100. Discuss AM and FM broadcast systems, classifications, power, components, interconnects, antenna systems, tests and logs.																	
101. Demonstrate technical proficiency regarding trouble-shooting, tuning, power measurements, studio and transmitter maintenance, proof of performance tests and FCC requirements.																	
102. Analyze and demonstrate thorough knowledge of various network, STL, and satellite interconnects and levels.																	
103. Demonstrate satisfactory ability to operate test equipment associated with broadcast.																	
104. Discuss and perform calculations required for microwave transmission.																	
105. Operate, tune and adjust microwave sources.																	
106. Calculate microwave antenna parameters.																	
107. Measure and record the following: a. Power and frequency b. Receive carrier levels c. Deviation using Bessel null function																	
108. Exhibit proficiency in radar operation and testing.																	
109. Orient and test both azel and polar-mount satellite antennas.																	

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	MICROPROCESSOR I	MICROPROCESSOR II	IMAGE SYSTEMS (VIDEO)	PRINTED CIRCUIT BOARDS	BASIC TRANSMITTERS AND RECEIVERS	ANTENNA SYSTEMS	ADVANCED IMAGE PROCESSING	ANALOG AND DIGITAL SYSTEMS WITH INTERFACE	MOBILE AND FIXED RADIO	TELEPHONE SYSTEMS	CABLE TELEVISION	BROADCAST RADIO AND TELEVISION	MICROWAVE AND SATELLITE	ELECTRONIC TECHNICIAN CERTIFICATION
95. Measure output power by direct and indirect methods.					*				*			*	*	
96. Measure signal, sensitivity, selectivity and signal-to-noise ratio in receivers.					*				*				*	
97. Analyze frequency synthesizers.					*				*					
98. Identify and analyze a variety of common types of coaxial transmission lines with respect to physical construction, impedance, velocity factor and line loss.						*								
99. Identify, install and test common types of coaxial connectors.					*				*		*	*	*	
100. Discuss AM and FM broadcast systems, classifications, power, components, interconnects, antenna systems, tests and logs.												*		
101. Demonstrate technical proficiency regarding trouble-shooting, tuning, power measurements, studio and transmitter maintenance, proof of performance tests and FCC requirements.												*		
102. Analyze and demonstrate thorough knowledge of various network, STL, and satellite interconnects and levels.													*	
103. Demonstrate satisfactory ability to operate test equipment associated with broadcast.												*		
104. Discuss and perform calculations required for microwave transmission.													*	
105. Operate, tune and adjust microwave sources.													*	
106. Calculate microwave antenna parameters.													*	
107. Measure and record the following: a. Power and frequency b. Receive carrier levels c. Deviation using bessel null function					* * *				* * *		* * *		* * *	
108. Exhibit proficiency in radar operation and testing.													*	
109. Orient and test both azel and polar-mount satellite antennas.						*							*	

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	COLLEGE ALGEBRA I	PLANE TRIGONOMETRY	COLLEGE PHYSICS	ELECTIVE ORIENT. OR SAFETY, ETC.	BASIC ELECTRONIC PRINCIPLES	COMPOSITION I	SPEECH COMMUNICATIONS	COMPUTER FAMILIARIZATION (BASIC)	INTERMEDIATE ELECTRONIC PRINCIPLES	GENERAL PSYCHOLOGY	ELECTRONIC DRAFTING	SOLID STATE DEVICES AND CIRCUITS I	SOLID STATE DEVICES AND CIRCUITS II	DIGITAL I	DIGITAL II	LASER AND FIBER OPTIC PRINCIPLES	LINEAR IC's (OP-AMPS)
110. Using a commercial mobile transceiver and service manual: a. Follow by drawing with color pencils the dc and ac signal tracks on block diagram, schematic, PC board layouts. b. Analyze the function of every circuit by measuring the dc and ac signals throughout the transceiver with a DMM, oscilloscope, modulated RF signal generator and frequency counter. c. Tune all stages to service manual specifications.											x						
111. Analyze repeater operations. Tune and adjust PL encoder/decoder, deviation tracking and duplexers.																	
112. Analyze, set signal levels and tune: a. Tone paging, alert and control systems. b. Telephone and RF link interconnects																	
113. Analyze the operation of: a. Trunking systems b. Cellular systems																	
114. Demonstrate knowledge of rules and regulations, franchise, and copyright.																	
115. Test, troubleshoot and repair processors, demodulators, modulators, line amplifiers (with/without AGC), extenders, and directional taps.																	
116. Set up CATV system levels, verify and log same.																	
117. Perform FCC system proof tests.																	
118. Analyze and layout small CATV plant.																	
119. Discuss types and classes of licensing, review subject material covered, take sample tests and critique same.																	
120. Demonstrate ability to understand written problems.	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	MICROPROCESSOR I	MICROPROCESSOR II	IMAGE SYSTEMS (VIDEO)	PRINTED CIRCUIT BOARDS	BASIC TRANSMITTERS AND RECEIVERS	ANTENNA SYSTEMS	ADVANCED IMAGE PROCESSING	ANALOG AND DIGITAL SYSTEMS WITH INTERFACE	MOBILE AND FIXED RADIO	TELEPHONE SYSTEMS	CABLE TELEVISION	BROADCAST RADIO AND TELEVISION	MICROWAVE AND SATELLITE	ELECTRONIC TECHNICIAN CERTIFICATION
110. Using a commercial mobile transceiver and service manual:														
a. Follow by drawing with color pencils the dc and ac signal tracks on block diagram, schematic, PC board layouts.									x					
b. Analyze the function of every circuit by measuring the dc and ac signals throughout the transceiver with a DVM, oscilloscope, modulated RF signal generator and frequency counter.									x					
c. Tune all stages to service manual specifications.									x					
111. Analyze repeater operations. Tune and adjust PL encoder/decoder, deviation tracking and duplexers.									x					
112. Analyze, set signal levels and tune:														
a. Tone paging, alert and control systems.									x					
b. Telephone and RF link interconnects									x	x				
113. Analyze the operation of:														
a. Trunking systems									x	x				
b. Cellular systems									x	x				
114. Demonstrate knowledge of rules and regulations, franchise, and copyright.											x			x
115. Test, troubleshoot and repair processors, demodulators, modulators, line amplifiers (with/without AGC), extenders, and directional taps.											x			
116. Set up CATV system levels, verify and log same.											x			
117. Perform FCC system proof tests.											x			x
118. Analyze and layout small CATV plant.											x			
119. Discuss types and classes of licensing, review subject material covered, take sample tests and critique same.														x
120. Demonstrate ability to understand written problems.	x	x	x	x	x	x	x	x	x	x	x	x	x	x

APPENDIX 15

North Harris County College Curriculum Competency versus Course Matrix

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	TECHNICAL MATHEMATICS I	TECHNICAL TRIGONOMETRY	ELECTRO-MECHANICAL HANDSKILLS	PHYSICAL EDUCATION	TECHNICAL PHYSICS	AMERICAN GOVERNMENT	COMPOSITION AND RHETORIC	TECHNICAL COMMUNICATION	CIRCUIT ANALYSIS I (DC)	CIRCUIT ANALYSIS II (AC)	DIGITAL ELECTRONICS	GENERAL PSYCHOLOGY	ELECTRONICS I	ELECTRONICS II	MICROPROCESSORS I	ANALOG & DIGITAL COMMUNICATIONS
1. Solve network problems using Kirchhoff, Thevenin, Norton, Superposition and Delta-Wye theorems.									x	x						
2. Set up instrumentation and measure a given voltage, current, resistance, power, and/or frequency using the appropriate VOM, DMM, oscilloscope, and/or frequency analyzer.									x	x						x
3. Analyze, construct, and/or troubleshoot:																
a. Series-parallel circuits									x	x						
b. Bridge circuits										x						
4. Troubleshoot, install, repair, and/or replace electronic circuits to the:																
a. Device level													x		x	
b. Board level													x		x	
c. Component level													x		x	
5. Analyze, construct, and/or troubleshoot series, parallel, or complex:																
a. RLC circuits										x				x		
b. Resonant circuits										x						x
c. Filter circuits										x						x
d. Polyphase circuits																
e. Amplifiers and equalization networks																x
6. Set up and operate:																
a. Frequency counters											x			x		x
b. Signal generators											x			x		x
c. Capacitor-inductor analyzers										x						x
d. Impedance bridges																x
e. Oscilloscopes										x	x		x			x
f. Sweep generators																x
g. Spectrum analyzers																x
h. Cable-fault analyzer																
7. Analyze, construct, measure characteristics of, and troubleshoot:																
a. Diode circuits													x			
b. Transistor circuits													x			
c. FET circuits														x		
d. Thyristor circuits														x		
e. SCRs														x		
f. TRIACs														x		
g. DIACs														x		
h. Light-emitting/detecting semiconductors																
8. Set up and use:																
a. Curve tracers													x			
b. Logic probes											x				x	x
c. Logic analyzers											x				x	x
d. Transistor testers													x	x		
9. Analyze, construct, and troubleshoot:																
a. Single-stage amplifiers														x		x
b. Multistage amplifiers															x	x
c. Power supplies										x				x		x
d. Oscillators																x

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	DATA COMMUNICATIONS	TELECOMMUNICATIONS SYSTEMS	TELECOMMUNICATIONS INDUSTRIAL APPLICATIONS
1. Solve network problems using Kirchhoff, Thevenin, Norton, Superposition and Delta-Wye theorems.			
2. Set up instrumentation and measure a given voltage, current, resistance, power, and/or frequency using the appropriate VOM, DMM, oscilloscope, and/or frequency analyzer.		x	
3. Analyze, construct, and/or troubleshoot:			
a. Series-parallel circuits			
b. Bridge circuits			
4. Troubleshoot, install, repair, and/or replace electronic circuits to the:			
a. Device level	x		x
b. Board level	x		x
c. Component level	x		x
5. Analyze, construct, and/or troubleshoot series, parallel, or complex:			
a. RLC circuits			
b. Resonant circuits			
c. Filter circuits			
d. Polyphase circuits			x
e. Amplifiers and equalization networks			
6. Set up and operate:			
a. Frequency counters			
b. Signal generators			
c. Capacitor-inductor analyzers			
d. Impedance bridges			
e. Oscilloscopes			
f. Sweep generators			
g. Spectrum analyzers			
h. Cable-fault analyzer		x	
7. Analyze, construct, measure characteristics of, and troubleshoot:			
a. Diode circuits			
b. Transistor circuits			
c. FET circuits			
d. Thyristor circuits			
e. SCRs			
f. TRIACs			
g. DIACs			
h. Light-emitting/detecting semiconductors			
8. Set up and use:			
a. Curve tracers			
b. Logic probes			
c. Logic analyzers			
d. Transistor testers			
9. Analyze, construct, and troubleshoot:			
a. Single-stage amplifiers		x	
b. Multistage amplifiers			
c. Power supplies			
d. Oscillators			

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	TECHNICAL MATHEMATICS I	TECHNICAL TRIGONOMETRY	ELECTRO-MECHANICAL HANDSKILLS	PHYSICAL EDUCATION	TECHNICAL PHYSICS I	AMERICAN GOVERNMENT	COMPOSITION AND RHETORIC	TECHNICAL COMMUNICATION	CIRCUIT ANALYSIS I (DC)	CIRCUIT ANALYSIS II (AC)	DIGITAL ELECTRONICS	GENERAL PSYCHOLOGY	ELECTRONICS I	ELECTRONICS II	MICROPROCESSORS I	ANALOG & DIGITAL COMMUNICATIONS
10. Analyze, troubleshoot, and repair advanced servomechanism systems.																
11. Read and sketch electronic schematics.			x						x		x					
12. Record data and design curves and graphs.									x							
13. State input and output speed, voltage and current characteristics of two logic families and RS232C devices.											x				x	
14. Identify electrical problems encountered when interfacing between logic families and RS232C devices.											x				x	
15. Build and test interfaces between TTL and CMOS circuits.											x				x	
16. Given a standard specification, determine whether or not a representative of any of the following logic circuits is operational:																
a. Gate, buffer/driver											x				x	
b. Buffer/driver											x				x	
c. Flip-flop											x				x	
d. Counter, shift register											x				x	
e. Selector											x				x	
f. Multiplexer/demultiplexer											x				x	
g. Comparator											x				x	
17. Explain the role of timing in communication; distinguish between synchronous and asynchronous transmission.																
18. Describe capacity of a channel in terms of bandwidth, baud-rate and grade.																
19. Describe communication mode possible by simplex, half-duplex and duplex links.																x
20. Use a shift register as a digital multiplexer and as a demultiplexer.											x					
21. Use an analog switch as an analog multiplexer and as a demultiplexer.											x					
22. Build a digital and an analog multiplexed data communication system; use each system to communicate information.																
23. Identify microcomputer ICs and determine function and logic from manual.															x	
24. Locate source of static hardware difficulties in small microcomputer systems.															x	
25. Use logic analyzer for dynamic testing of microcomputer systems.											x				x	

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	DATA COMMUNICATIONS	TELECOMMUNICATIONS SYSTEMS	TELECOMMUNICATIONS INDUSTRIAL APPLICATIONS
10. Analyze, troubleshoot, and repair advanced servomechanism systems.			x
11. Read and sketch electronic schematics.			
12. Record data and design curves and graphs.			
13. State input and output speed, voltage and current characteristics of ten logic families and RS232C devices.	x		
14. Identify electrical problems encountered when interfacing between logic families and RS232C devices.	x		
15. Build and test interfaces between TTL and CMOS circuits.			
16. Given a standard specification, determine whether or not a representative of any of the following logic circuits is operational:			
a. Gate, buffer/driver			
b. Buffer/driver			
c. Flip-flop			
d. Counter, shift register	x		
e. Selector			
f. Multiplexer/demultiplexer	x		
g. Comparator			
17. Explain the role of timing in communication; distinguish between synchronous and asynchronous transmission.	x		
18. Describe capacity of a channel in terms of bandwidth, baud-rate and grade.	x		
19. Describe communication made possible by simplex, half-duplex and duplex links.	x		
20. Use a shift register as a digital multiplexer and as a demultiplexer.	x		
21. Use an analog switch as an analog multiplexer and as a demultiplexer.			
22. Build a digital and an analog multiplexed data communication system; use each system to communicate information.	x		
23. Identify microcomputer ICs and determine function and logic from manual.			
24. Locate source of static hardware difficulties in small microcomputer systems.			
25. Use logic analyzer for dynamic testing of microcomputer systems.			

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	TECHNICAL MATHEMATICS I	TECHNICAL TRIGONOMETRY	ELECTRO-MECHANICAL HANDSKILLS	PHYSICAL EDUCATION	TECHNICAL PHYSICS	AMERICAN GOVERNMENT	COMPOSITION AND RHETORIC	TECHNICAL COMMUNICATION	CIRCUIT ANALYSIS I (DC)	CIRCUIT ANALYSIS II (AC)	DIGITAL ELECTRONICS	GENERAL PSYCHOLOGY	ELECTRONICS I	ELECTRONICS II	MICROPROCESSORS I	ANALOG & DIGITAL COMMUNICATIONS
26. Analyze, troubleshoot, and repair:																
a. ECL logic families											x					
b. LSI circuits															x	
27. Analyze and troubleshoot firmware using defined hardware.															x	
28. Analyze, construct, troubleshoot:																
a. CPUs															x	
b. BUS systems															x	
c. Memory systems															x	
d. Input/output ports															x	
29. Analyze, construct and troubleshoot microprocessor applications and systems.															x	
30. Analyze and troubleshoot microcomputer systems.															x	
31. Breadboard A/D and D/A circuits.																x
32. Interface a specified microprocessor to an input/output measurement system.															x	
33. Construct or install:																
a. Station (JKT, UBDC blocks, 25-pair cable, colors)																
b. Jumper wires																
c. Punch-down techniques																
34. Repair and/or replace:																
a. Station (JKT, UBDC blocks, 25-pair cable, colors)																
b. Jumper wires																
c. Punch-down techniques																
35. Read and interpret:																
a. Attached and detached contact schematics																
b. T-drawings																
c. Office drawings																
36. Define and give standard examples using the terms:																
a. Baud															x	
b. Modem															x	
c. PBX															x	
37. Identify the tone-pair assignments for:																
a. DTMF																
b. MF																
38. Identify and describe the differences between the five classes of telephone offices.																
39. Discuss the various multiplexing methods employed in telephony systems.																
40. Identify the frequency allocations for RF energy as governed by:																
a. ITU																x
b. FCC																x

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	DATA COMMUNICATIONS	TELECOMMUNICATIONS SYSTEMS	TELECOMMUNICATIONS INDUSTRIAL APPLICATIONS
26. Analyze, troubleshoot, and repair: a. ECL logic families b. LSI circuits			
27. Analyze and troubleshoot firmware using defined hardware.			
28. Analyze, construct, troubleshoot: a. CPUs b. BUS systems c. Memory systems d. Input/output ports			
29. Analyze, construct and troubleshoot microprocessor applications and systems.	x		
30. Analyze and troubleshoot microcomputer systems.			
31. Breadboard A/D and D/A circuits.			
32. Interface a specified microprocessor to an input/output measurement system.			
33. Construct or install: a. Station (JKT, USOC blocks, 25-pair cable, colors) b. Jumper wires c. Punch-down techniques			
34. Repair and/or replace: a. Station (JKT, USOC blocks, 25-pair cable, colors) b. Jumper wires c. Punch-down techniques			
35. Read and interpret: a. Attached and detached contact schematics b. T-drawings c. Office drawings			
36. Define and give standard examples using the terms: a. Baud b. Modem c. PBX	 x x x		
37. Identify the tone-pair assignments for: a. DTMF b. MF	 x x		 x x
38. Identify and describe the differences between the five classes of telephone offices.	x		
39. Discuss the various multiplexing methods employed in telephony systems.	x		x
40. Identify the frequency allocations for RF energy as governed by: a. ITU b. FCC			

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	TECHNICAL MATHEMATICS I	TECHNICAL TRIGONOMETRY	ELECTRO-MECHANICAL HANDSKILLS	PHYSICAL EDUCATION	TECHNICAL PHYSICS	AMERICAN GOVERNMENT	COMPOSITION AND RHETORIC	TECHNICAL COMMUNICATION	CIRCUIT ANALYSIS I (DC)	CIRCUIT ANALYSIS II (AC)	DIGITAL ELECTRONICS	GENERAL PSYCHOLOGY	ELECTRONICS I	ELECTRONICS II	MICROPROCESSORS I	ANALOG & DIGITAL COMMUNICATIONS
41. Match frequency ranges to banks (VLF, LF, MF, HF, VHF, UHF, and SHF).																x
42. Identify and translate messages in the codes:																
a. Q-signals																
b. 10-code																
c. Baudot 5-bit code																
d. ASCII 7/8 bit code																
e. EBCDIC																
43. Set up and measure:																
a. VSWR																x
b. Attenuation																x
c. Insertion loss																x
44. Troubleshoot and replace:																
a. Klystron tubes																
b. TWTs																
c. Magnetrons																
d. Varactors																
e. Gunn diodes																
f. Tunnel diodes																
g. Step-recovery diodes																
h. YIG tuned																
45. Identify, set up, tune and test waveguide transmission lines.																
46. Troubleshoot, repair and/or replace transmission-line sections.																
47. Use Smith chart for impedance calculations with transmission lines.																x
48. Select, set up, connect, troubleshoot and repair the following antennas:																
a. Monopole																x
b. Dipole																x
c. Folded dipole																x
d. Logarithmically periodic																x
e. Conical																x
f. Helical																x
g. Loop																x
h. Rhombic																x
i. Slot																x
j. Horn																x
49. Describe signal propagation effects for antennas with respect to reflector elements and parasitic elements.																x
50. Troubleshoot:																
a. HF transmitters																x
b. HF receivers																x
c. Single-sideband transceiver																x
d. With the two-tone test																x
51. Repair and align:																
a. Linear amplifiers																x
b. Video transmission equipment																
52. Measure, align and test:																
a. SSB/CW/AM receiver performance																x
b. Microwave lines																x
c. FM transmitter																x

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	DATA COMMUNICATIONS	TELECOMMUNICATIONS SYSTEMS	TELECOMMUNICATIONS INDUSTRIAL APPLICATIONS
41. Match frequency ranges to bands (VLF, LF, MF, HF, VHF, UHF, and SHF).			
42. Identify and translate messages in the codes:			
a. Q-signals			
b. 10-code			
c. Baudot 5-bit code	x		
d. ASCII 7/8 bit code	x		
e. EBCDIC	x		
43. Set up and measure:			
a. VSWR			
b. Attenuation			
c. Insertion loss			
44. Troubleshoot and replace:			
a. Klystron tubes		x	
b. TWTs		x	
c. Magnetrons		x	
d. Varactors		x	
e. Gunn diodes		x	
f. Tunnel diodes		x	
g. Step-recovery diodes		x	
h. YIG tuned		x	
45. Identify, set up, tune and test waveguide transmission lines.		x	
46. Troubleshoot, repair and/or replace transmission-line sections.			
47. Use Smith chart for impedance calculations with transmission lines.			
48. Select, set up, connect, troubleshoot and repair the following antennas:			
a. Monopole			
b. Dipole			
c. Folded dipole			
d. Logarithmically periodic			
e. Conical			
f. Helical			
g. Loop			
h. Rhombic			
i. Slot			
j. Horn			
49. Describe signal propagation effects for antennas with respect to reflector elements and parasitic elements.			
50. Troubleshoot:			
a. HF transmitters			
b. HF receivers			
c. Single-sideband transceiver			
d. With the two-tone test			
51. Repair and align:			
a. Linear amplifiers			
b. Video transmission equipment			x
52. Measure, align and test:			
a. SSB/CW/AM receiver performance			
b. Microwave lines			
c. FM transmitter			

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	TECHNICAL MATHEMATICS I	TECHNICAL TRIGONOMETRY	ELECTRO-MECHANICAL HANDSKILLS	PHYSICAL EDUCATION	TECHNICAL PHYSICS	AMERICAN GOVERNMENT	COMPOSITION AND RHETORIC	TECHNICAL COMMUNICATION	CIRCUIT ANALYSIS I (DC)	CIRCUIT ANALYSIS II (AC)	DIGITAL ELECTRONICS	GENERAL PSYCHOLOGY	ELECTRONICS I	ELECTRONICS II	MICROPROCESSORS I	ANALOG & DIGITAL COMMUNICATIONS
53. Analyze frequency synthesizers:																
a. PLL type																x
b. LSI type																x
54. Perform or check calibration of:																
a. Test instrument meters									x	x						
b. Frequency counters																x
c. Spectrum analyzers																x
55. For optical fibers measure: a. Transmission loss b. Scattering and absorption loss c. Accuracy d. Length (via reflectometry methods) e. Spectral attenuation f. Frequency response g. Refractive index profile h. Impulse response																
56. Splice optical fibers where/when required.																
57. Use connectors for alignment and coupling of light source into fiber.																
58. Install, troubleshoot, and replace: a. LED light sources b. Solid-state lasers c. Electro-optic modulators d. Acousto-optic devices e. Photodetectors																
59. Recognize resistor values using the standard resistor color code and identify different types of resistors such as thermistors, voltage-dependent resistors, variable resistors and others.									x							
60. Recognize and test common electronic components such as capacitors and inductors, and determine their values by common markings.										x						
61. Determine power, impedance, admittance, susceptance and other applicable values of complex series and/or parallel R-C-L Circuits.										x						
62. Analyze dc and ac motors and generators.																
63. Identify/name families of linear and logic integrated circuits.											x				x	

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	DATA COMMUNICATIONS	TELECOMMUNICATIONS SYSTEMS	TELECOMMUNICATIONS INDUSTRIAL APPLICATIONS
53. Analyze frequency synthesizers:			
a. PLL type			
b. LSI type			
54. Perform or check calibration of:			
a. Test instrument meters			
b. Frequency counters	x		
c. Spectrum analyzers	x		
55. For optical fibers measure:			
a. Transmission loss		x	
b. Scattering and absorption loss		x	
c. Accuracy		x	
d. Length (via reflectometry methods)		x	
e. Spectral attenuation		x	
f. Frequency response		x	
g. Refractive index profile		x	
h. Impulse response		x	
56. Splice optical fibers where/when required.		x	
57. Use connectors for alignment and coupling of light source into fiber.		x	
58. Install, troubleshoot, and replace:			
a. LED light sources		x	
b. Solid-state lasers		x	
c. Electro-optic modulators		x	
d. Acousto-optic devices		x	
e. Photodetectors		x	
59. Recognize resistor values using the standard resistor color code and identify different types of resistors such as thermistors, voltage-dependent resistors, variable resistors and others.			
60. Recognize and test common electronic components such as capacitors and inductors, and determine their values by common markings.			
61. Determine power, impedance, admittance, susceptance and other applicable values of complex series and/or parallel R-C-L Circuits.			
62. Analyze dc and ac motors and generators.			
63. Identify/name families of linear and logic integrated circuits.			

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	TECHNICAL MATHEMATICS I	TECHNICAL TRIGONOMETRY	ELECTRO-MECHANICAL HANDSKILLS	PHYSICAL EDUCATION	TECHNICAL PHYSICS	AMERICAN GOVERNMENT	COMPOSITION AND RHETORIC	TECHNICAL COMMUNICATION	CIRCUIT ANALYSIS I (DC)	CIRCUIT ANALYSIS II (AC)	DIGITAL ELECTRONICS	GENERAL PSYCHOLOGY	ELECTRONICS I	ELECTRONICS II	MICROPROCESSORS I	ANALOG & DIGITAL COMMUNICATIONS
64. Analyze function and operation, construct, measure, and troubleshoot commonly used semiconductor circuits.																
a. Power supplies			x							x			x			x
b. AF/RF amplifiers													x			x
c. AF/RF oscillators, generators, clocks																x
d. Wave-shaping circuits																x
e. Filters																x
65. Demonstrate knowledge of:																
a. Drafting techniques			x													
b. Lettering procedures			x													
c. Use of drafting instruments			x													
66. Identify and classify items as being either analog or digital in nature.																x
67. Convert between binary, octal, hexadecimal, decimal and BCD number systems.											x					
68. Analyze, design and troubleshoot digital circuits using logic gates and flip-flops.											x					
69. Use Boolean algebra to express logic operations.											x					
70. Given a standard specification, determine whether or not a representative of any of the following logic circuits is operational:																
a. Gate, buffer/driver											x					
b. Buffer/driver											x					
c. Flip-flop											x					
d. Counter, shift register											x					
e. Multiplexer/demultiplexer											x					
f. Comparator											x					
71. Analyze, construct and troubleshoot sequential logic circuits such as binary and BCD counters and shift registers.											x					
72. Identify, analyze and troubleshoot various types of semiconductor memories: RAMs, ROMs, etc.															x	
73. Analyze and troubleshoot various types of data convertors.																
74. Build and test interfaces between TTL and CMOS circuits.											x					
75. Analyze, construct, troubleshoot:																
a. Memory systems and address decoders															x	
b. Input/output ports															x	
c. A to D and D to A convertors																x

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	DATA COMMUNICATIONS	TELECOMMUNICATIONS SYSTEMS	TELECOMMUNICATIONS INDUSTRIAL APPLICATIONS
64. Analyze function and operation, construct, measure, and troubleshoot commonly used semiconductor circuits. a. Power supplies b. AF/RF amplifiers c. AF/RF oscillators, generators, clocks d. Wave-shaping circuits e. Filters			
65. Demonstrate knowledge of: a. Drafting techniques b. Lettering procedures c. Use of drafting instruments			
66. Identify and classify items as being either analog or digital in nature.			
67. Convert between binary, octal, hexadecimal, decimal and BCD number systems.			
68. Analyze, design and troubleshoot digital circuits using logic gates and flip-flops.			
69. Use Boolean algebra to express logic operations.			
70. Given a standard specification, determine whether or not a representative of any of the following logic circuits is operational: a. Gate, buffer/driver b. Buffer/driver c. Flip-flop d. Counter, shift register e. Multiplexer/demultiplexer f. Comparator			
71. Analyze, construct and troubleshoot sequential logic circuits such as binary and BCD counters and shift registers.			
72. Identify, analyze and troubleshoot various types of semiconductor memories: RAMs, ROMs, etc.			
73. Analyze and troubleshoot various types of data convertors.	x		
74. Build and test interfaces between TTL and CMOS circuits.			
75. Analyze, construct, troubleshoot:			
a. Memory systems and address decoders	x		
b. Input/output ports	x		
c. A to D and D to A convertors			

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	TECHNICAL MATHEMATICS I	TECHNICAL TRIGONOMETRY	ELECTRO-MECHANICAL HANDSKILLS	PHYSICAL EDUCATION	TECHNICAL PHYSICS	AMERICAN GOVERNMENT	COMPOSITION AND RHETORIC	TECHNICAL COMMUNICATION	CIRCUIT ANALYSIS I (DC)	CIRCUIT ANALYSIS II (AC)	DIGITAL ELECTRONICS	GENERAL PSYCHOLOGY	ELECTRONICS I	ELECTRONICS II	MICROPROCESSORS I	ANALOG & DIGITAL COMMUNICATIONS
76. Construct, analyze and troubleshoot circuits containing operational amplifiers.														x		
77. Measure and compute common OP-AMP parameters.														x		
78. Discuss optical terms and concepts related to lasers and fiber optics.																
79. Recognize safety hazards associated with all types of lasers.																
80. Draw dc and ac signal paths on electronic block diagrams, schematics, and printed circuit board layouts.									x	x						
81. Design PC board layouts from schematics.			x													
82. Construct PC boards using manual artwork, dry transfer on copper-clad board, and photographic methods.			x													
83. Troubleshoot, install, repair, and/or replace electronic circuits on PC boards at component level.			x													
84. Protect PC board by tin plating and by using chemical sprays.			x													
85. Repair damaged PC board lands.			x													
86. Discuss and demonstrate imaging systems, capture, processing and display.																
87. Analyze, configure, troubleshoot and repair the following systems: a. Vidicon and CCD cameras b. Video monitors c. Video LCD displays d. Video scanners																
88. Analyze and test digital video processors.																
89. Analyze, troubleshoot and repair various video recorders.																
90. Discuss and test digital recorders.																
91. Process, manipulate and convert various image formats.																
92. Construct and test basic CW transmitter.																x
93. Construct basic receiver to detect AM, SSB, and FM.																x
94. Analyze transmitted signals in both the time and frequency domains.																x

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	DATA COMMUNICATIONS	TELECOMMUNICATIONS SYSTEMS	TELECOMMUNICATIONS INDUSTRIAL APPLICATIONS
76. Construct, analyze and troubleshoot circuits containing operational amplifiers.			
77. Measure and compute common OP-AMP parameters.			
78. Discuss optical terms and concepts related to lasers and fiber optics.		x	
79. Recognize safety hazards associated with all types of lasers.		x	
80. Draw dc and ac signal paths on electronic block diagrams, schematics, and printed circuit board layouts.			
81. Design PC board layouts from schematics.			
82. Construct PC boards using manual artwork, dry transfer on copper-clad board, and photographic methods.			
83. Troubleshoot, install, repair, and/or replace electronic circuits on PC boards at component level.			
84. Protect PC board by tin plating and by using chemical sprays.			
85. Repair damaged PC board lands.			
86. Discuss and demonstrate image systems, capture, processing and display.		x	x
87. Analyze, configure, troubleshoot and repair the following systems:			
a. Videcon and CCD cameras		x	x
b. Video monitors		x	x
c. Video LCD displays		x	x
d. Video scanners		x	x
88. Analyze and test digital video processors.	x		
89. Analyze, troubleshoot and repair various video recorders.			
90. Discuss and test digital recorders.			
91. Process, manipulate and convert various image formats.		x	
92. Construct and test basic CW transmitter.			
93. Construct basic receiver to detect AM, SSB, and FM.			
94. Analyze transmitted signals in both the time and frequency domains.			

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	TECHNICAL MATHEMATICS I	TECHNICAL TRIGONOMETRY	ELECTRO-MECHANICAL HANDSKILLS	PHYSICAL EDUCATION	TECHNICAL PHYSICS	AMERICAN GOVERNMENT	COMPOSITION AND RHETORIC	TECHNICAL COMMUNICATION	CIRCUIT ANALYSIS I (DC)	CIRCUIT ANALYSIS II (AC)	DIGITAL ELECTRONICS	GENERAL PSYCHOLOGY	ELECTRONICS I	ELECTRONICS II	MICROPROCESSORS I	ANALOG & DIGITAL COMMUNICATIONS
95. Measure output power by direct and indirect methods.										x						x
96. Measure signal, sensitivity, selectivity and signal-to-noise ratio in receivers.																x
97. Analyze frequency synthesizers.																
98. Identify and analyze a variety of common types of coaxial transmission lines with respect to physical construction, impedance, velocity factor and line loss.																x
99. Identify, install and test common types of coaxial connectors.																
100. Discuss AM and FM broadcast systems, classifications, power, components, interconnects, antenna systems, tests and logs.																x
101. Demonstrate technical proficiency regarding trouble-shooting, tuning, power measurements, studio and transmitter maintenance, proof of performance tests and FCC requirements.																
102. Analyze and demonstrate thorough knowledge of various network, STL, and satellite interconnects and levels.																
103. Demonstrate satisfactory ability to operate test equipment associated with broadcast.																x
104. Discuss and perform calculations required for microwave transmission.																
105. Operate, tune and adjust microwave sources.																
106. Calculate microwave antenna parameters.																
107. Measure and record the following:																
a. Power and frequency																x
b. Receive carrier levels																
c. Deviation using bessel null function																x
108. Exhibit proficiency in radar operation and testing.																
109. Orient and test both azel and polar-mount satellite antennas.																

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	DATA COMMUNICATIONS	TELECOMMUNICATIONS SYSTEMS	TELECOMMUNICATIONS INDUSTRIAL APPLICATIONS
95. Measure output power by direct and indirect methods.		x	
96. Measure signal, sensitivity, selectivity and signal-to-noise ratio in receivers.		x	
97. Analyze frequency synthesizers.			x
98. Identify and analyze a variety of common types of coaxial transmission lines with respect to physical construction, impedance, velocity factor and line loss.		x	
99. Identify, install and test common types of coaxial connectors.		x	
100. Discuss AM and FM broadcast systems, classifications, power, components, interconnects, antenna systems, tests and logs.			
101. Demonstrate technical proficiency regarding trouble-shooting, tuning, power measurements, studio and transmitter maintenance, proof of performance tests and FCC requirements.			x
102. Analyze and demonstrate thorough knowledge of various network, STL, and satellite interconnects and levels.			x
103. Demonstrate satisfactory ability to operate test equipment associated with broadcast.			
104. Discuss and perform calculations required for microwave transmission.		x	
105. Operate, tune and adjust microwave sources.		x	
106. Calculate microwave antenna parameters.		x	
107. Measure and record the following: a. Power and frequency b. Receive carrier levels c. Deviation using bessel null function			
108. Exhibit proficiency in radar operation and testing.			
109. Orient and test both azel and polar-mount satellite antennas.			x

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	TECHNICAL MATHEMATICS I	TECHNICAL TRIGONOMETRY	ELECTRO-MECHANICAL HANDSKILLS	PHYSICAL EDUCATION	TECHNICAL PHYSICS	AMERICAN GOVERNMENT	COMPOSITION AND RHETORIC	TECHNICAL COMMUNICATION	CIRCUIT ANALYSIS I (DC)	CIRCUIT ANALYSIS II (AC)	DIGITAL ELECTRONICS	GENERAL PSYCHOLOGY	ELECTRONICS I	ELECTRONICS II	MICROPROCESSORS I	ANALOG & DIGITAL COMMUNICATIONS
110. Using a commercial mobile transceiver and service manual:																
a. Follow by drawing with color pencils the dc and ac signal tracks on block diagram, schematic, PC board layouts.																x
b. Analyze the function of every circuit by measuring the dc and ac signals throughout the transceiver with a DMM, oscilloscope, modulated RF signal generator and frequency counter.																x
c. Tune all stages to service manual specifications.																x
111. Analyze repeater operations. Tune and adjust PL encoder/decoder, deviation tracking and duplexers.																
112. Analyze, set signal levels and tune: a. Tone paging, alert and control systems. b. Telephone and RF link interconnects																
113. Analyze the operation of: a. Trunking systems b. Cellular systems																
114. Demonstrate knowledge of rules and regulations, franchises, and copyright.																
115. Test, troubleshoot and repair processors, demodulators, modulators, line amplifiers (with/without AGC), extenders, and directional taps.																
116. Set up CATV system levels, verify and log same.																
117. Perform FCC system proof tests.																
118. Analyze and layout small CATV plant.																
119. Discuss types and classes of licensing, review subject material covered, take sample tests and critique same.																
120. Demonstrate ability to understand written problems.									x	x	x		x			

JOB COMPETENCIES TELECOMMUNICATIONS TECHNICIANS	DATA COMMUNICATIONS	TELECOMMUNICATIONS SYSTEMS	TELECOMMUNICATIONS INDUSTRIAL APPLICATIONS
110. Using a commercial mobile transceiver and service manual:			
a. Follow by drawing with color pencils the dc and ac signal tracks on block diagram, schematic, PC board layouts.			
b. Analyze the function of every circuit by measuring the dc and ac signals throughout the transceiver with a DMM, oscilloscope, modulated RF signal generator and frequency counter.			
c. Tune all stages to service manual specifications.			
111. Analyze repeater operations. Tune and adjust PL encoder/decoder, deviation tracking and duplexers.	x		
112. Analyze, set signal levels and tune:			
a. Tone paging, alert and control systems.			x
b. Telephone and RF link interconnects			x
113. Analyze the operation of:			
a. Trunking systems	x		
b. Cellular systems	x		
114. Demonstrate knowledge of rules and regulations, franchise, and copyright.			
115. Test, troubleshoot and repair processors, demodulators, modulators, line amplifiers (with/without AGC), extenders, and directional taps.			
116. Set up CATV system levels, verify and log same.			
117. Perform FCC system proof tests.			
118. Analyze and layout small CATV plant.			
119. Discuss types and classes of licensing, review subject material covered, take sample tests and critique same.			
120. Demonstrate ability to understand written problems.	x		

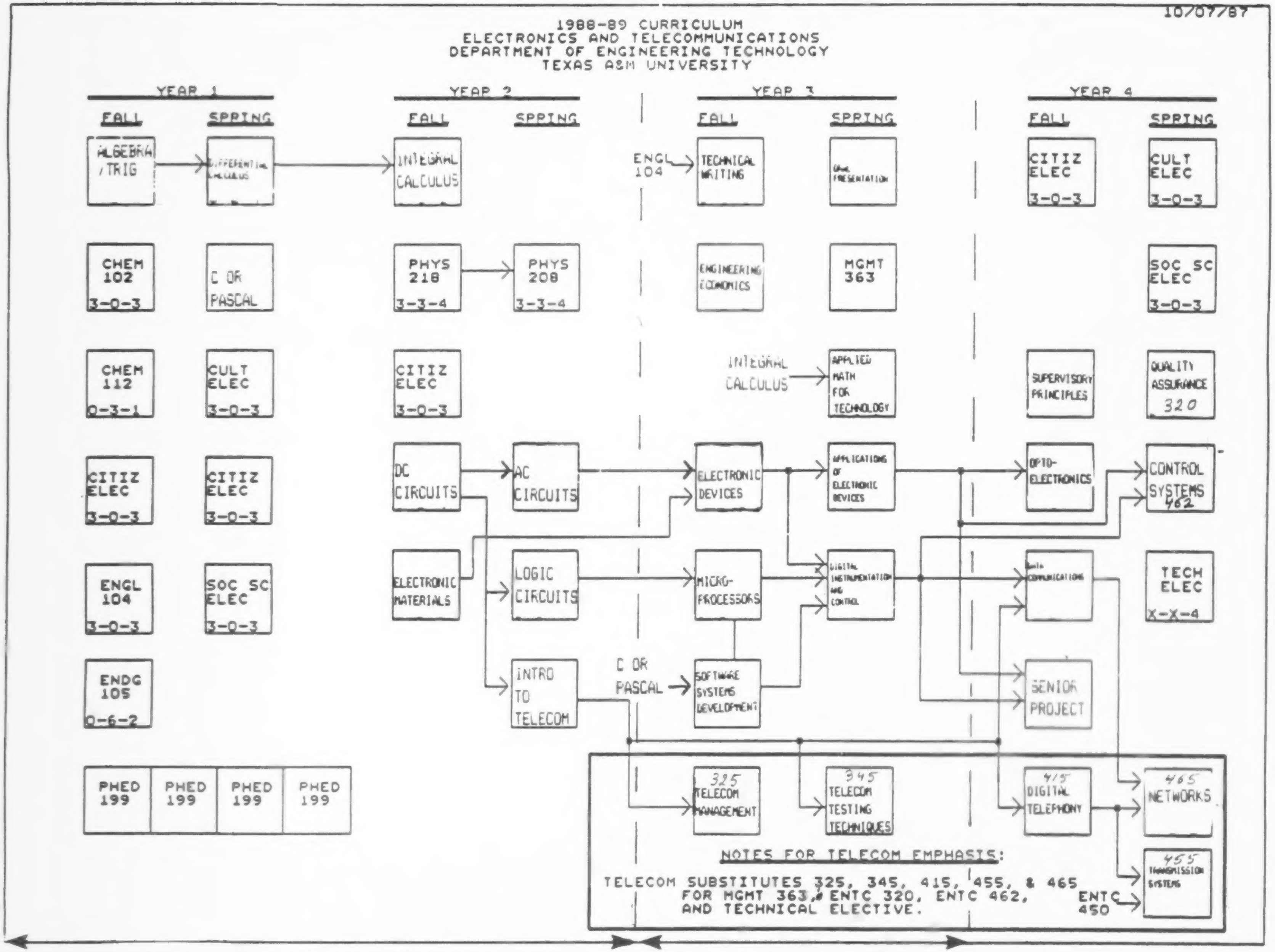
Appendix 16

EXAMPLE ARTICULATION CHART

Texas Tech University	Allowable Credits: Semester Hrs.	TSTI-Sweetwater	Allowable Credits: Quarter Hrs.
Humanities and Social Studies			
ENGL 1301	(3 HRS)	ENGL 104	(3 HRS)
ENGL 2309	(3 HRS)	ENGL 134	(3 HRS)
Basic Sciences and Mathematics			
PHYS 1306 & 1103	(4 HRS)	PHYS 134	(3 HRS)
PHYS 1307 & 1104	(4 HRS)		
MATH 1320	(3 HRS)	MATH 104	(3 HRS)
MATH 1321	(3 HRS)	MATH 124	(3 HRS)
General Engineering Technology			
GTEC 1311	(3 HRS)	CST 123	(2 HRS)
GTEC 2321	(3 HRS)	ELT 111	(4 HRS)
Technology Specialty			
EET 1312	(3 HRS)	ELT 123	(4 HRS)
EET 2311	(3 HRS)	ELT 121	(2 HRS)
EET 2312	(3 HRS)	ELT 122	(4 HRS)
EET 2314	(3 HRS)	CMT 213	(2 HRS)
EET 2331	(3 HRS)	ELT 214	(3 HRS)

Note: The student must take GTEC 4331 (3.0 hrs) special project credit to cover some of the courses taken at TSTI, because the quarter system is not equivalent to semester system. This chart is an example only.

APPENDIX 17
EXAMPLE ARTICULATION CHART



10/07/87

1988-89 CURRICULUM
ELECTRONICS AND TELECOMMUNICATIONS
DEPARTMENT OF ENGINEERING TECHNOLOGY
TEXAS A&M UNIVERSITY

YEAR 1
FALL
SPRING
YEAR 2
FALL
SPRING
YEAR 3
FALL
SPRING
YEAR 4
FALL
SPRING
ALGEBRA /TRIG
DIFFERENTIAL CALCULUS
INTEGRAL CALCULUS
CHEM 102 3-0-3
C OR PASCAL
PHYS 218 3-3-4
PHYS 208 3-3-4
CHEM 112 0-3-1
CULT ELEC 3-0-3
CITIZ ELEC 3-0-3
CITIZ ELEC 3-0-3
CITIZ ELEC 3-0-3
DC CIRCUITS
AC CIRCUITS
ENGL 104 3-0-3
SOC SC ELEC 3-0-3
ELECTRONIC MATERIALS
LOGIC CIRCUITS
ENDG 105 0-6-2
INTRO TO TELECOM
PHED 199
PHED 199
PHED 199
PHED 199
ENGL 104
TECHNICAL WRITING
ORAL PRESENTATION
ENGINEERING ECONOMICS
MGMT 363
INTEGRAL CALCULUS
APPLIED MATH FOR TECHNOLOGY
ELECTRONIC DEVICES
APPLICATIONS OF ELECTRONIC DEVICES
MICRO-PROCESSORS
DIGITAL INSTRUMENTATION AND CONTROL
C OR PASCAL
SOFTWARE SYSTEMS DEVELOPMENT
325 TELECOM MANAGEMENT
345 TELECOM TESTING TECHNIQUES
CITIZ ELEC 3-0-3
CULT ELEC 3-0-3
SOC SC ELEC 3-0-3
SUPERVISORY PRINCIPLES
QUALITY ASSURANCE 320
OPTO-ELECTRONICS
CONTROL SYSTEMS 462
DATA COMMUNICATIONS
TECH ELEC X-X-4
SENIOR PROJECT
415 DIGITAL TELEPHONY
465 NETWORKS
455 TRANSMISSION SYSTEMS
ENTC 450

NOTES FOR TELECOM EMPHASIS:

TELECOM SUBSTITUTES 325, 345, 415, 455, & 465 FOR MGMT 363, ENTC 320, ENTC 462, AND TECHNICAL ELECTIVE.

CREDIT FOR THESE COURSES CAN BE TRANSFERRED FROM TWO-YEAR COLLEGES.

CREDIT FOR THESE COURSES CAN BE OBTAINED BY EXAMINATION, BUT NOT BY SIMPLE TRANSFER.

180
180

APPENDIX 18
EQUIPMENT LIST

An equipment list follows which is based on a class of ten (10) students. Certain items are instructional trainers, other items are the actual equipment used in industry. Trainers offer the concepts but deprive the students hands-on experience with field equipment. An ideal list would contain more industry equipment in the advanced classes.

Computer Operating Systems I	5 IBM AT Computers 3 Printers 2 Modems
Basic Electronic Circuits	5 Heath ETW 3100 Analog Trainers 5 Oscilloscopes, 15 MHz, dual trace 5 VOM Simpson 260 5 DMM 5 Frequency Counters 0-100 MHZ 3 Function Generators 1 Desoldering Station
Advanced Electronic Circuits	Same as above
Solid State Devices	Same as above
Solid State Circuits	Same as above
Linear IC's	Same as above
Digital I	5 Heath ETW 3300 Digital Trainers 5 DMM 5 Oscilloscopes, 15 MHz, dual trace
Digital II	Same as above
Optolaser Technology	5 Heath EWS 4200 Laser Trainers
Microprocessor I	5 Heath ETW 3400A 5 DMM 5 Ocilloscopes
Microprocessor II	Same as above
Printed Circuit Boards	1 Small Drill Press 1 PC Board Shear 1 Exposure Lamp 2 Pyrex trays 2 Contact Printers Necessary chemicals and presentsitized boards.

Laser and Fiber Optic Principles	5 Laser Trainers (Heath EWS 4200) 5 Opto - Electronic Trainers (SIP 375 1-2-3) 10 Panel Base (S300 PB) 10 Power Supply Base (S300 PBS)
Basic Transmitter and Receiver	5 AM Radio Trainers (SIP 327 A) 5 FM Radio Trainers (SIP 328 D) 5 AM/DBS Transmitter Trainers (SIP 350) 5 FM Transmitter Trainers (SIP 355) 5 Telecommunication Radio Trainers (SIP 329)
Antenna and Transmission Lines	5 Ant. and Transmission Line Trainers (SIP 360) 5 Microwave Ant. Trainers (SIP 365)
Analog and Digital Systems	5 Digital Communications Trainers (SIP 397 1-2-3-4) 2 IBM compatible computers with modems
Telephone Systems	5 Tel Multiplex Trainers
Broadcast	Same Equipment as Basic TX and RX and Cable TV
Microwave and Satellite	1 Satellite Ant. with block down converter 2 Satellite Receivers for above 5 Microwave Trainers (SIP 365) 1 Microwave Spectrum Analyzer
Mobile and Fixed	1 Service Monitor with tracking generator and cellular options (1 FR 1200) 4 Service Monitors with Input amplifier (1 FR 500) 5 RF Wattmeters, Bird 5 RF Dummy Loads, Bird 5 D.C. Power Supplies. 20 amps. 5 FM Mobile Radios
Cable T.V.	2 Spectrum Analyzer's: 0-1000 MHz 2 Sweep Generators: 0-1000 MHz 5 Signal level Meter (SAM I) 1 Cable TV Processor 1 Cable TV Modulator 1 Cable TV De-Modulator

APPENDIX 19

LIST OF REFERENCES

Title	Author	Published by
Electric Circuits	Theodure F. Bogart	Macmillam Co.
Practical Transistors and Linear Integrated circuits	Joseph Greenfield	John Wiley
Digital Electronics A Practical Approach	Willaim Kleitz	Prentice Hall
Digital Circuits	Kenneth Muchow, A. Zeppa,& B. Green	Prentice Hall
Op-Amps/Linear Integrated circuits 2nd edition	Ramakant Gayakwad	Prentice Hall
Electronic Communications Modulation & Transmission	Robert Schoenbeck	Merrill
Data Communications	William Schweber	McGraw-Hill
Digital Communications Satellite/Earth station Engineering	Kamilo Feher	Prentice Hall
Telecommunications Voice/Data with Fiber Optic Applications	Wayne Tomasi and Vincent Allsouskas	Prentice Hall
Microwave and Fiber Optics communications	Arthur Wickersham	Prentice Hall
Microprocessor system servicing	J. D. Ferguson	Prentice Hall
Troubleshooting Micro-processor based system	Allen Robbins & Brian Lundeen	Prentice Hall
Microcomputer system hardware, Essembly language and Pascal	Charles A. Holt	Prentice Hall
RS-232 simplifed; everything you need to know about connecting, interfacing, and trouble-shooting peripheral devices.	Byron W. Putman	Prentice Hall

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